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2005 Assessment of Pollock in 4VWX and 5Zc

Évaluation de 2005 de la goberge dans 4VWX et 5Zc

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ABSTRACT

Landings of pollock in the 4VWX/5Zc fishery in 2005/06 are 4698 t as of October 27, against a quota of 6500 t. An assessment was completed using input data through the second trimester of 2005. Reduced quotas and harvests have contributed to a decline in fishing mortality rates for older fish (ages 6-9), but fishing mortality remains high, and above the F_{ref} of 0.2. Biomass declined from about 60,000 t in 1984 to about 10,000 t in 1999. Biomass has been rebuilding since 1999, doubling to about 20,000 t in 2003, but the rebuilding has been arrested. The fishery weight at age has been decreasing from about 1984, and the trend is most apparent for the younger ages (ages 3-5). The 1999 year-class was the strongest at age 2 since 1990. Initial indications for the 2002 year-class is that it is the weakest in the series. If the 2002 year-class is as weak as estimated, biomass will decrease in 2006 to 13,000 t, before increasing again to about 17,000 t in 2007. The range of harvest strategies in the fishing year that are risk averse (25% risk of exceeding F_{ref}) to risk neutral (50% risk of exceeding F_{ref}) are about 1400 to 1800 t. Several factors (few older fish in the population, fishing mortality remains well above the target levels, the 2002 year-class is the weakest on record, the fishery is spatially constricted and the modest biomass rebuilding has been arrested) indicate a more conservative harvesting strategy than that employed in 2005 is urgently required. The objective of achieving rebuilding for cod and pollock may constrain the harvesting of haddock.

RÉSUMÉ

Les débarquements de goberge dans 4VWX/5Zc en 2005-2006 s'élevaient à 4 698 t au 27 octobre, par rapport à un quota de 6 500 t. Une évaluation a été réalisée à l'aide des données obtenues jusqu'au second trimestre de 2005. La baisse des quotas et des prises a contribué à la diminution du taux de mortalité des poissons âgés (âges 6 à 9), mais la mortalité par pêche reste élevée, supérieure au point de référence $F_{réf}$ de 0,2. La biomasse, qui avait diminué de 1984 (60 000 t) à 1999 (10 000 t) a commencé à augmenter depuis, ayant doublé en 2003, atteignant environ 20 000 t, mais le rétablissement est maintenant interrompu. Le poids des prises selon l'âge augmente depuis 1984 à peu près, la tendance étant surtout évidente chez les jeunes poissons (âges 3 à 5). La classe d'âge de 1999 a été la plus forte à l'âge 2 depuis 1990. Selon les données préliminaires, la classe d'âge de 2002 serait la plus faible de la série chronologique. Si elle est aussi faible qu'on l'estime, la biomasse diminuera en 2006 à 13 000 t avant de remonter à environ 17 000 t en 2007. L'éventail des stratégies de capture utilisées pendant l'année de pêche allant de prudentes (25 % de risque de dépasser $F_{réf}$) à neutres (50 % de risque de dépasser $F_{réf}$) sont d'environ 1 400 t à 1 800 t. Plusieurs facteurs (peu de poissons âgés au sein de la population, la mortalité par pêche demeure bien supérieure aux niveaux cibles, la classe d'âge de 2002 est la plus faible jamais enregistrée, la pêche est géographiquement limitée et le rétablissement modeste de la biomasse est arrêté) montrent qu'il serait pressant de mettre en place une stratégie de pêche plus prudente que celle de 2005. L'objectif de rétablissement de la morue et de la goberge pourrait restreindre la pêche de l'aiglefin.

INTRODUCTION

Pollock in the management unit 4VWX and 5Zc are assessed as Western (5Zc, 5Yb, 4Xopqrs) and Eastern Components (4Xmn, 4VW) (Fig. 1), following the recommendations of the Framework Assessment completed in 2004 (Neilson et al. 2004a). Unless otherwise noted, the assessment results presented below refer to the Western Component.

In 2005, the Terms of Reference were to report on the status of the Western Component of pollock, updating results for the latest information from fisheries including all bycatch and discard estimates and from research surveys. For a range of Western Component pollock TAC options in 2006/2007, the assessment was to include estimates of the risk that the 2006/2007 fishing mortality rate would exceed the $F_{ref} = 0.2$ and that the biomass at the beginning of April 2007 would not achieve a 0%, 10% or 20% increase compared to the beginning of April 2006. The assessment was also to report on the status of Eastern Component of pollock, updating results with the latest research survey for trends of abundance, total mortality rates and biomass ratio of Eastern Component to Western Component pollock. Finally, the implications of maintaining the current management on the biological stock components was to be addressed, and suggestions of how Fisheries Management could accommodate these implications.

THE FISHERY

Recent landings for the entire management unit have generally been less than the TAC (Fig. 2). Calendar year landings through August 31, 2005 are 6180 t (Table 1) and landings during the fishing year from April 1 through August 31, 2005 are 4017 t against a quota of 6500 t. Calendar year landings by country for the Western Component are shown in Table 2. The Western Component of the management unit since 1991 usually contributes the largest proportion of the landings (Fig. 3). Landings from the Eastern Component traditionally come from the tonnage class 4+ sector and similar to the Western Component, have also followed a decreasing trend (Fig. 3). Within the Western Component, a large proportion (80%) of the landings were from two unit areas (4Xp and 5Zc), where recently, landings were spread among the different unit areas to a greater extent (Table 3a, Fig. 4). Fig 5 shows this gradual constriction of the fishery by TC 1-3 trawlers from 1991 to 2005, summarized by 10 minute squares.

Since 1993, much of the Eastern Component has been closed to cod-directed fishing, which further reduces pollock landings from that area (Table 3b, Fig. 3). Landings in the fishery from NAFO Unit Area 4Xn increased slightly in 2005, in the vicinity of LaHave basin (Fig. 5).

The seasonal pattern of the fishery in 2005 varied compared with previous years, with proportionately more pollock caught in February and March. In 2005,

this activity happened mainly in 4Xp, as the 2004/2005 fishing year drew to an end (Table 4).

The contributions of the TC 1-3 trawlers have increased since 2000 and now account for 80% of the total landings (Fig. 6). Gillnet landings comprised 17% of the total landings in 2005, showing a decreasing trend since 2000 (Table 5, Fig. 6). The contribution of large otter trawlers (Tonnage Class 4+) accounted for only 1% of total removals in 2005. There have been industry reports of discarding in 2005, but the extent of this problem is not known. Lack of sufficient observer coverage did not allow for the estimation of discards in 2005.

SAMPLING AND CATCH/WEIGHT AT AGE

The level of commercial fishery sampling was relatively low in the 1970s in NAFO Division 4X, thus the assessment presented here starts at 1982 when the level of sampling improved to reflect the fishery more accurately. To construct the catch at age for 2005, data for the Western Component were aggregated to the trimester level by gear type and tonnage class. Area 4Xu was prorated over the Western Component by allocating the proportion of landings attributed to 4Xmn versus the remaining unit areas in 4X.

Commercial fishery samples were selected and paper records examined to determine location of fishing. Any sampled trip that did not fish entirely within the Western Component was excluded. Samples were aggregated on a trimester basis for OTB 1-3 and gillnet and on an annual basis for OTB 4+, longline and handline and miscellaneous gear because of limited data.

Length-weight parameters were calculated from data pooled over the last ten years (1996-2005; a period of stability in the yearly length-weight parameters at length 50 cm) from the summer RV survey for strata 474, 476 and 480-495 (the Western Component). Since no surveys are conducted in the spring or fall, the summer value is used for the first and third trimesters.

Strong and weak year-classes are apparent in the age structure and cohorts are readily tracked (Table 6, Fig. 7).The period of diminished numbers at age during the 1990s continues until the present with few fish older than age 8 in the catch at age. In 2005, ages 4 and 6 are above the ten year average (Fig. 8) with age 6 (1999 year-class) at its highest value since 1998 (Fig. 7). This strong year-class was first noted in last year's assessment (Neilson et al. 2004b). Ages 5 and 6 are close to the projected catch while the catch at age 4 was well above that projected (Fig. 8). Tables 7-10 provide gear-specific details of the catch at age. For mobile gear, ages 4-6 comprise most of the catch, but for gillnets, ages 5, 6 and 7 are dominant.

Overall, the weight at age series has been decreasing for all ages from about 1984 (Fig. 9). At the older ages, there was an increase during the late nineties (Table 11, Fig. 9), but in the last three to four years the weight at age for the older ages has been decreasing.

INDICES OF ABUNDANCE

The catch rate series is based on catch rates from individual areas in the Western Component (NAFO Unit Areas 4Xq, 4Xp/5Zc, Bay of Fundy (4Xrs and 5Yb) and 4Xo) and then combined using a weighted area approach as the number of productive 10' squares in that area in 1992 (a year of high landings) divided by the total number of productive 10' squares in all areas in 1992. Details of the calculations may be found in Neilson et al. 2004a.

The catch rate time series of mobile gear (TC 2-3) is shown in Fig. 10. Catch rates have generally declined from a peak in 1984 to a low in1999 then increased to 2002, and since then have followed a slight declining trend. Examining catch rates by area, one area is contributing to the stability of the index in recent years, 4Xp/5Zc (Fig. 10), this increase however, is offset by the decrease in the other areas resulting in a stable or slightly declining index. Age-specific indices of abundance from the mobile gear sector of the fishery show a continued absence of older (7+) fish since 1996 (Neilson et al. 2004a, Fig. 11). There is potential for an improved age structure with the passage of the strong 1999 year-class (age 6) in 2005. The 1999 year-class (age 6) is the highest value in the CPUE time series since 1986 (Fig. 11, Table 12) while early indications suggest that the 2002 year-class is very weak.

Indices from research vessels are also used in this assessment. While a single research vessel has been used from 1984 – 2003 (CCGS Needler), a replacement vessel (CCGS Teleost) was used in 2004 only. Both vessels completed the 2005 survey, fishing in a side by side manner. The indices at age obtained from each vessel in 2005 are shown in Table 13 and Fig. 12, and indicate comparable estimation of numbers at age.

The trend in the stratified mean catch per tow from the summer research surveys, while highly variable, has declined since the mid 1980s until 1999, with slight improvement in the age-aggregated indices recently (Fig. 13). Consistent with the catch rate information, the 1999 year-class appears strong from 2003-2005 (Table 13, Fig. 12). The 1999 year class has resulted in improved numbers at age 6 and the 1998 year-class shows improved numbers at age 7 (Fig. 12).

The ITQ survey is a fixed station survey conducted annually by small otter trawlers (Tonnage Class 3) throughout NAFO Division 4X in July since 1996. While this survey provides information on the spatial distribution of the pollock resource, it is not considered to provide a useful index of abundance (Carruthers

et al. 2003). However, pollock in the 2005 survey were generally caught at the same locations as the average from 1996-2004, except in the mouth of the Bay of Fundy where catches were lower, and the eastern shelf edge (Fig. 14).

ESTIMATION OF CURRENT POPULATION STATE

The current population status was determined using the ADAPT formulation following the approach outlined in Neilson et al. (2004a) with the following adjustments. For the 2005 assessment, age 2 only was assigned a fixed value based on recent observed recruitment. Fishing mortality at age 9 for 2004 and 2005 was assumed to be equal to the population number weighted average fishing mortality on ages 7 and 8.

Population Model Results

Given the similarity in perception of year-class strength in 2005 obtained from the *CCGS Needler* (Fig. 12), comparative fishing results that showed no significant differences between the two vessels, and the same overall fit to the population model (Table 14, MSR=0.572 for both runs), it was concluded that it was appropriate to include the 2004 observation.

The 2004 assessment considered indices through 2003 only (Neilson et al 2004b). The 2005 assessment adds indices for 2004 and 2005. Diagnostic plots using age-specific relationships are shown in Fig. 15 and 16 for the commercial CPUE and RV indices respectively. Although there is some indication of time-trended residuals, the model fits were generally considered adequate.

Estimates of population numbers at age are provided in Table 15 and Fig. 17. A period of much-diminished numbers at age in older ages during the 1990s continues to be apparent in the current population numbers at age. However, the 2005 age structure is dominated by the 2001 and 1999 (age 4 and 6) year-classes with some indication of an improved age structure with the 1998 year-class (age 7).

Trends in fishing mortality are shown with respect to total landings in Table 16 and Fig. 18. Estimates of fishing mortality have steadily increased from the early 1980s to 1994, in spite of decreased landings. Fishing mortality decreased in 1995 and 1996 but increased again in to a maximum in 1998 when landings also increased. Fishing mortality on ages 6-9 have decreased over the past year but still remains well above $F_{ref.}$ There has been little change in fishing mortality for ages 4-9 (Fig. 18).

Age 2+ population biomass trends have declined from 22440 in 2004 to 19893 t in 2005 and age 4+ biomass has declined from 18708 to 18252 t (Table

17). Projecting forward one trimester to the end of the current fishing year, biomass drops to 16407 and 12823 for age 2+ and 4+ respectively (Fig. 19).

Of some concern are the estimates of the 2002 year-class at age 2 which are the lowest in the time series (Fig. 20). While the estimate of the size of the year-class is based on indices from the current (2005) survey and the 2005 (partial year) commercial catch rates, should this estimate be verified in subsequent years, the scope for growth of the population will be adversely affected by this weak recruitment.

The complete stock assessment results are shown in Appendix One.

The statistical properties of the population model are shown in Table 18. While the age-specific estimates of population numbers and calibration constants are sometimes associated with high variance, they are comparable to those reported in the assessment of this resource in 2004.

PROJECTIONS OF CATCH AND POPULATION BIOMASS

Given the observed trends in the weights at age and relative proportion of different gear types (that could be reflected in the PR pattern), a short 3 year series from 2003-2005, including the partial year, was used for the partial recruitment and weights at age for the projection (Table 19). The partial year was included in the calculation because in previous years, the increment of growth observed in the final trimester was inconsequential. For the projections of population biomass (Appendix One), landings from January 1, 2005 to August 31, 2005 of 4017 t and an additional 2500 t were assumed to be caught by the end of the quota year (March 31, 2006). The population biomass is expected to decline to about 1300 t by the end of the quota year. The deterministic projection for $F_{0.1}$ removals in the next fishing year is 1623 t for the Western Component. This pessimistic outlook is related to the very weak incoming 2002 year-class, a trend of declining weights at age, and a decline in population biomass during the current fishing year (Fig. 19).

Fig. 21 shows the risk of exceeding exploitation or biomass targets. The range of harvest strategies in the fishing year that are risk averse (25% risk of exceeding F_{ref}) to risk neutral (50% risk of exceeding F_{ref}) are about 1400 to 1800 t.

The population has a high likelihood of achieving an increase in biomass over the 2005/2006 fishing year with removals as high as about 4000 t. However, it is important to note that the increase projected follows after a period of decline, and 46% of the projected population 4+ biomass is due to assumed recruitment. There is a likelihood that removals in fishing year 2006/2007 as high as expected for fishing year 2005/2006 will further reduce population biomass.

EASTERN COMPONENT

While most of the fishery now occurs within the Western Component, there remains a need to provide advice on the status of the resource on the Eastern Component. The distribution of catches from the 2005 RV survey is shown in Fig. 22. A few notable catches of pollock, near the western boundary of the Eastern Component have caused an unexpected increase in the age 4 and 5 indices in 2005 (Fig. 23). Smoothed estimates of total mortality from the survey remain high however (Fig. 24). The proportion of biomass from the Eastern Component is about 25% of the total, averaged over the past three years (Fig. 25). Indices from the summer research vessel, while extremely variable, indicate that total mortality remains high and generally increasing, even with relatively small landings from the fishery. Large scale directed pollock fisheries should not be considered until the Eastern Component rebuilds.

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Table 1. Calendar year landings of pollock by country in 4VWX5Zc. The landings for 2005 represent a partial year (Jan 1 to Aug. 31).

	Canada	Japan	France	Fed. Rep. Germany	German Dem. Rep.	Cuba	USSR (Russia)	USA	Spain	Other	Total
1974	24975	40		149			2301	435	1500	61	29461
1975	26548			236	95		2004	403	708	124	30118
1976	23565			994	24		1466	443	303	385	27180
1977	24653	1		368			182	325		53	25582
1978	26801	110	33			141	502	451			28038
1979	29967	19	23			50	1025	391		7	31482
1980	35986	81	99			32	950	443			37591
1981	40270	15	90				358	918			41651
1982	38029	3	44			84	297	1107			39564
1983	32749	6	22			261	226	1854			35118
1984	33465	1	46			123	97	2272		1	36005
1985	43300	17	77			66	336	152			43948
1986	43249	51	77			387	564	234		4	44566
1987	45330	82	28			343	314	102			46199
1988	41831	1				225	1054	60			43171
1989	41112	1				99	1782	35			43029
1990	36178					261	1040	213			37692
1991	37931	38				459	1177	68			39673
1992	32002	72	9			1015	1006	57			34161
1993	20253					644	176				21073
1994	15240					10					15250
1995	9781					58					9839
1996	9145					129	6				9280
1997	11927					64					11991
1998	14371					9	1				14381
1999	7738					6					7744
2000	5672										5672
2001	6318										6318
2002	7090										7090
2003	8090										8090
2004	8353										8353
2005	6180										6180

Table 2. Pollock landings (t) by country for the Western Component (4Xopqrs, 5Yb in Canadian waters and 5Zc). The landings for 2005 represent a partial year (Jan 1 to Aug. 31).

	Canada	USA	Total
1982	18518	1107	19625
1983	16465	1854	18319
1984	15347	2272	17619
1985	19511	152	19663
1986	17520	234	17754
1987	16460	102	16562
1988	17899	60	17959
1989	13724	35	13759
1990	15595	213	15808
1991	18602	68	18670
1992	16639	57	16696
1993	14410		14410
1994	10836		10836
1995	7144		7144
1996	6441		6441
1997	9759		9759
1998	10534		10534
1999	4760		4760
2000	4768		4768
2001	5400		5400
2002	6485		6485
2003	7839		7839
2004	8006		8006
2005	5806		5806

Table 3a. Calendar year pollock landings (t) by area in the Western Component, (4Xopqrs, 5Yb in Canadian waters and 5Zc). The landings for 2005 represent a partial year (Jan 1 to Aug. 31).

	4Xo	4Xp	4Xq	4Xr	4Xs	4Xu	5Yb	5Zc	Total
1982	4781	1499	2675	2508	1345	183	925	4430	18347
1983	4337	1146	3635	1170	461	1319	1079	3301	16448
1984	3536	1189	4541	716	163	1933	2015	1199	15291
1985	6179	595	5718	1284	696	3275	853	911	19511
1986	7326	1073	2531	1046	1287	2066	654	1538	17520
1987	4734	2329	1893	508	1209	2571	1120	2096	16460
1988	3194	3417	3333	307	790	4110	345	2403	17899
1989	3619	3373	2334	332	374	1777	531	1385	13724
1990	3668	2523	2953	1042	693	2629	346	1740	15595
1991	4621	3745	2665	2465	2105	831	456	1715	18602
1992	4174	1528	2626	2175	1793	865	443	3036	16639
1993	2754	1985	2226	1605	941	337	368	4193	14410
1994	1860	1097	1213	1453	866	784	236	3327	10836
1995	429	1158	2552	676	393	683	250	1004	7144
1996	419	1478	1811	686	412	179	256	1200	6441
1997	446	1574	4030	1112	607	447	311	1231	9759
1998	437	3495	3134	564	469	153	425	1857	10534
1999	313	879	1372	648	380	37	135	996	4760
2000	257	1086	1531	264	249	47	136	1197	4768
2001	207	1191	1774	301	186	68	104	1569	5400
2002	201	1482	2628	189	159	52	157	1616	6485
2003	114	1823	2578	403	665	316	594	1347	7839
2004	58	2404	2342	321	557	147	137	2047	8012
2005	82	3015	747	114	182	35	66	1564	5806

Table 3b. Calendar year pollock landings (t) by area in the Eastern Component, (4Xmn, 4W 4V). The landings for 2005 represent a partial year (Jan 1 to Aug. 31).

	4Vn	4Vs	4Vu	4Wd	4We	4Wf	4Wg	4Wh	4Wj	4Wk	4Wl	4Wm	4Wu	4Xm	4Xn	Total
1982	149	2216	162	4	89	8	230	904	3181	1987	2469	25	69	4341	3154	18987
1983	104	5214	13	7	189	24	621	1577	235	1725	702	7	191	2713	2532	15855
1984	351	4598	101	5	60	9	207	1699	252	2061	1406		106	2251	3805	16912
1985	839	9375	7	79	80	6	1002	198	32	1156	247		43	4803	3014	20882
1986	1379	11639	138	202	30	2	658	289	454	986	239		220	4124	2448	22808
1987	915	9680	303	70	26	0	416	92	659	2302	29		154	4947	5987	25583
1988	1448	9307	224	128	85	10	746	124	44	934	841		165	5020	2599	21674
1989	4465	7542		253	79	30	313	253	272	1394	931	6	309	4239	5689	25774
1990	2124	6065		90	20	80	769	160	300	1172	1093	46	350	3078	3886	19233
1991	1043	3009		193	42	7	2146	132	477	1329	2229	106	72	2824	5172	18779
1992	284	2129		149	98	13	990	101	162	1064	2695	44	387	1594	5357	15066
1993	86	743		81	470	1	114	6	5	588	272	1	63	739	2563	5731
1994	437	329		19	434	0	69	11	4	787	60		6	878	1128	4161
1995	397	665		36	3	0	108	31	1	130	188	6	135	220	592	2513
1996	30	432		35	0	0	19	44	0	747	67	1	81	305	898	2660
1997	10	135		7	1	0	1	94	0	606	66	1	73	305	770	2071
1998	155	171		11	16	0	36	63	2	149	1160	1	20	257	1767	3806
1999	29	422		0	0		80	61	1	1067	248	0	3	247	803	2963
2000	6	234		0	0		20	2	0	145	85	0	7	153	239	891
2001	0	94		0	0		7	2	0	128	151	2	15	146	336	882
2002	0	39			0		0	2	0	37	39	0	1	77	317	513
2003	0	4		0	0		1	5	0	15	37	0	4	24	152	243
2004	0	9						2	0	25	135		1	25	144	340
2005	0	3					0	1	0	14	6		7	30	314	374

Table 4. Calendar year pollock landings (t) by month in the Western Component, (4Xopqrs, 5Yb in Canadian waters and 5Zc). The landings for 2005 represent a partial year (Jan 1 to Aug. 31). Unit area 4Xu was not prorated (Neilson et al. 2004a).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1982	766	667	258	196	1555	2789	3413	2510	2317	2085	1140	620	18317
1983	1147	805	477	495	1814	4650	3272	1659	1207	568	172	77	16344
1984	167	170	362	753	1413	3922	3818	1619	1325	1090	346	91	15076
1985	114	681	841	1892	981	4503	5243	1885	1556	1048	357	222	19323
1986	1023	682	758	452	2221	3015	3678	2649	2069	664	169	23	17404
1987	1428	648	643	34	2212	3686	2797	1905	1431	490	114	836	16224
1988	1043	563	140	375	912	4213	4534	1241	1159	409	151	2561	17301
1989	645	1473	329	459	712	3740	1682	1230	1140	561	1317	320	13607
1990	244	233	44	132	1039	3199	3465	2944	2002	1182	465	923	15874
1991	1091	884	433	1235	1884	3435	3189	2136	1750	1335	729	681	18783
1992	432	625	222	783	1744	2916	3073	2414	1813	1572	817	232	16644
1993	1089	654	633	385	1202	2725	2741	1684	1172	550	900	629	14363
1994	36	244	228	517	801	1931	2950	1350	1061	903	473	489	10981
1995	106	217	206	472	319	2013	1406	255	1472	255	300	180	7200
1996	277	199	222	223	470	786	1226	914	544	606	387	604	6457
1997	56	458	508	681	597	1482	1917	1392	1209	661	560	282	9802
1998	285	624	807	711	953	1872	2193	1109	986	789	165	51	10544
1999	64	59	174	236	348	781	1112	825	666	215	180	111	4771
2000	135	272	301	98	318	738	850	684	553	506	184	140	4778
2001	231	46	417	224	418	775	1180	566	610	534	261	146	5410
2002	139	268	328	415	947	1346	1266	599	505	345	221	121	6501
2003	39	235	941	643	893	1171	1205	901	877	450	374	116	7845
2004	48	514	871	527	676	1806	1547	764	560	367	245	85	8012
2005	398	1065	547	448	536	1459	832	520					5806

Table 5. Calendar year pollock landings (t) by gear in the Western Component, (4Xopqrs, 5Yb in Canadian waters and 5Zc). The landings for 2005 represent a partial year (Jan 1 to Aug. 31). Unit area 4Xu was prorated (Neilson et al. 2004a).

	Gillnet	OTB 4+	Longline	Misc	OTB 1-3	Total
1982	2574	6782	2315	241	6435	18347
1983	2416	4307	1618	25	8081	16448
1984	1809	1623	1615	39	10204	15291
1985	3045	1246	2443	52	12725	19511
1986	4378	1928	4447	55	6712	17519
1987	4003	3465	2934	26	6032	16460
1988	3021	5904	1704	93	7177	17899
1989	4217	3558	1391	78	4480	13724
1990	4810	3027	2252	95	5411	15595
1991	3572	3884	2387	132	8627	18602
1992	3784	3135	2789	3	6928	16639
1993	3159	3983	2199	1	5067	14410
1994	2760	1703	2019	44	4310	10836
1995	2620	951	506	4	3062	7144
1996	1301	1733	605	3	2799	6441
1997	2312	1648	978	1	4820	9759
1998	3076	1323	621	21	5492	10534
1999	1431	546	494	5	2286	4761
2000	1796	516	278	5	2172	4768
2001	1776	564	291	1	2765	5398
2002	1621	559	229	1	4074	6484
2003	1902	11	217	9	5699	7839
2004	2017	90	121	1	5782	8012
2005	979	78	99	0	4647	5803

Table 6. Total catch at age (000s) for pollock in the Western Component (4Xopqrs, 5Yb in Canadian waters and 5Zc). The catch at age for 2005 includes Jan - August 31.

	2	3	4	5	6	7	8	9	10	11	12
1982	95	1618	1352	371	1031	838	425	145	45	33	13
1983	45	1283	3966	854	179	314	291	138	59	17	19
1984	4	370	1832	2751	465	85	148	114	41	19	2
1985	5	195	621	1806	2142	328	38	100	99	62	30
1986	1	162	1410	1136	1329	876	88	37	37	41	15
1987	5	104	628	1622	883	786	490	68	17	15	28
1988	19	425	990	1126	1281	519	424	242	22	14	20
1989	93	386	1533	1129	576	463	147	129	65	6	7
1990	47	776	1102	1621	873	429	174	138	49	23	10
1991	58	1013	1900	1506	1395	347	157	56	49	25	10
1992	46	1250	2678	1651	675	314	124	96	61	14	12
1993	4	551	1989	2125	1143	318	92	27	10	7	6
1994	51	259	675	1327	1151	494	166	59	14	8	2
1995	24	263	537	949	676	294	63	17	4	1	1
1996	14	202	949	710	473	256	55	15	0	0	1
1997	6	151	900	1654	780	217	54	4	0	1	0
1998	7	228	829	1368	1262	307	47	16	2	1	0
1999	13	89	496	621	426	173	22	4	1	2	0
2000	86	581	404	592	319	139	27	6	1	0	0
2001	15	335	814	571	314	91	14	5	2	1	1
2002	7	191	787	1073	416	127	20	6	1	0	0
2003	2	111	1302	1331	513	120	18	5	1	1	0
2004	2	173	542	1876	696	118	13	4	2	1	0
2005	0	29	767	612	1032	133	11	4	0	0	0

Table 7. Small mobile gear otter trawl (TC 1-3) catch at age (000s) for pollock in the Western Component, (4Xopqrs, 5Yb in Canadian waters and 5Zc). The catch at age for 2005 include Jan 1 – August 31.

	2	3	4	5	6	7	8	9	10	11	12
1982	39	719	438	104	297	264	144	57	20	15	6
1983	18	751	2209	386	55	88	88	39	17	6	6
1984	4	183	1019	1652	295	53	87	66	24	11	1
1985	3	115	413	1310	1505	215	18	47	47	28	11
1986	1	75	557	452	527	340	29	11	14	16	5
1987	4	50	297	643	317	279	171	25	5	5	8
1988	1	106	302	492	596	222	187	95	10	3	6
1989	17	256	798	414	177	110	27	21	9	1	0
1990	28	403	531	668	294	111	36	26	9	4	1
1991	14	361	1008	783	620	150	72	26	19	9	4
1992	22	683	1605	814	215	59	18	14	8	1	2
1993	0	256	1002	858	320	70	21	7	3	1	2
1994	29	137	331	592	465	178	60	19	5	3	1
1995	21	206	306	463	269	96	21	4	2	1	0
1996	4	107	546	375	187	82	13	2	0	0	0
1997	5	93	556	958	338	79	14	1	0	0	0
1998	5	173	573	839	651	118	18	5	0	0	0
1999	9	61	343	365	197	54	6	1	0	0	0
2000	65	391	250	310	127	40	7	2	1	0	0
2001	15	291	538	286	134	31	6	2	1	0	0
2002	7	172	636	739	219	56	9	2	1	0	0
2003	2	108	1210	1087	304	50	6	2	1	1	0
2004	2	170	493	1558	440	52	5	2	1	1	0
2005	0	29	755	578	827	60	4	1	0	0	0

Table 8. Large mobile gear otter trawl (TC 4+) catch at age (000s) for pollock in the Western Component, (4Xopqrs, 5Yb in Canadian waters and 5Zc). The catch at age for 2005 include Jan 1 – August 31.

	2	3	4	5	6	7	8	9	10	11	12
1982	48	781	787	191	433	279	113	34	11	8	3
1983	27	504	1351	260	71	116	90	37	15	3	5
1984	0	167	583	564	65	11	18	13	4	4	0
1985	1	61	79	117	129	22	4	6	7	3	1
1986	0	28	173	134	187	109	7	2	4	4	1
1987	1	46	175	367	198	141	89	16	4	5	8
1988	18	314	593	405	377	143	96	39	3	4	5
1989	75	124	546	333	108	87	27	20	10	2	1
1990	18	351	423	403	153	42	14	10	3	2	1
1991	41	569	509	300	225	47	20	6	7	3	1
1992	16	437	718	310	87	32	10	7	4	1	0
1993	4	222	643	645	259	60	12	4	2	2	2
1994	9	42	125	254	184	60	18	5	1	1	0
1995	0	31	103	154	82	28	6	1	1	0	0
1996	9	76	313	192	115	59	10	3	0	0	0
1997	1	33	181	318	113	33	4	0	0	0	0
1998	1	32	157	214	144	23	4	1	0	0	0
1999	2	17	71	82	42	13	2	0	0	0	0
2000	19	138	57	52	20	8	2	0	0	0	0
2001	0	36	138	56	18	5	1	0	0	0	0
2002	0	15	75	100	36	8	1	0	0	0	0
2003	0	0	2	3	1	0	0	0	0	0	0
2004	0	1	12	29	4	0	0	0	0	0	0
2005	0	0	5	7	16	2	0	0	0	0	0

Table 9. Gillnet gear catch at age (000s) for pollock in the Western Component (4Xopqrs, 5Yb in Canadian waters and 5Zc). The catch at age for 2005 include Jan 1 – August 31.

	2	3	4	5	6	7	8	9	10	11	12
1982	0	4	52	46	181	163	80	25	5	3	1
1983	0	23	372	164	37	61	49	18	6	1	1
1984	0	6	92	234	56	15	34	27	10	3	1
1985	0	14	118	317	347	43	4	6	8	3	1
1986	0	6	246	294	369	226	19	4	2	5	1
1987	0	5	99	364	215	208	132	13	5	2	5
1988	0	4	64	133	163	82	89	79	7	6	8
1989	0	4	161	295	211	188	71	63	33	2	5
1990	0	9	102	404	313	192	79	63	19	9	3
1991	0	23	183	214	338	98	43	16	16	8	3
1992	0	14	102	296	261	148	59	40	26	6	6
1993	0	17	134	318	333	127	47	14	5	4	2
1994	1	3	20	141	306	191	66	25	6	3	1
1995	2	24	100	263	272	148	31	10	1	0	0
1996	0	3	42	97	128	84	20	5	0	0	0
1997	0	12	105	252	233	77	27	2	0	1	0
1998	0	6	60	258	404	139	19	7	1	0	0
1999	0	7	58	130	141	80	9	2	0	0	0
2000	0	34	76	190	149	81	16	4	0	0	0
2001	0	4	105	198	144	48	6	2	0	0	0
2002	0	3	65	209	143	54	8	3	1	0	0
2003	0	1	58	201	196	65	11	3	0	0	0
2004	0	2	28	255	243	65	8	2	1	1	0
2005	0	0	7	26	174	64	6	2	0	0	0

Table 10. Longline and miscellaneous gear catch at age (000 s) for pollock in the Western Component, (4Xopqrs, 5Yb in Canadian waters and 5Zc). The catch at age for 2005 include Jan 1 – August 31.

	2	3	4	5	6	7	8	9	10	11	12
1982	8	115	75	31	121	132	88	30	9	8	3
1983	0	4	34	43	16	49	63	44	21	8	7
1984	0	14	138	301	49	6	9	8	2	1	0
1985	0	4	11	62	160	47	12	41	37	28	16
1986	0	52	433	256	246	201	33	19	16	16	8
1987	0	3	58	249	153	159	98	14	3	3	7
1988	0	1	31	96	145	72	52	29	3	1	2
1989	0	3	28	86	80	78	22	25	13	2	1
1990	0	13	46	145	113	85	45	40	18	9	5
1991	3	59	201	209	213	51	23	8	7	5	3
1992	7	115	254	231	112	73	37	35	23	6	3
1993	0	56	210	304	231	61	13	2	0	0	0
1994	12	77	200	340	196	65	22	9	3	1	0
1995	0	3	27	69	54	22	5	1	1	0	0
1996	1	16	48	46	43	31	11	5	0	0	0
1997	0	13	57	127	96	27	8	1	0	0	0
1998	1	17	38	58	63	26	6	3	1	0	0
1999	1	4	24	44	45	25	5	1	1	1	0
2000	2	17	21	40	23	9	2	1	0	0	0
2001	0	4	32	31	18	6	1	1	0	0	0
2002	0	1	10	25	18	9	2	1	0	0	0
2003	0	1	30	41	13	5	1	0	0	0	0
2004	0	1	10	33	9	1	0	0	0	0	0
2005	0	0	0	1	16	8	1	0	0	0	0

Table 11. Mean weights at age (kg) for pollock from the commercial landings in the Western Component, (4Xopqrs, 5Yb in Canadian waters and 5Zc).

	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12
1982	0.000	0.943	1.427	2.529	3.462	4.211	4.772	5.681	6.239	7.687	8.622	10.621
1983	0.000	0.881	1.349	1.983	3.373	4.367	5.105	5.651	6.624	7.220	8.381	8.886
1984	0.000	0.914	1.635	2.331	3.005	4.078	5.401	6.062	6.208	6.661	7.230	9.725
1985	0.000	0.974	1.615	2.462	3.169	3.695	4.296	6.022	7.315	7.185	7.968	9.343
1986	0.000	0.738	1.554	2.306	3.095	3.929	4.530	5.791	6.651	7.161	7.322	8.698
1987	0.000	0.943	1.475	2.266	3.046	3.564	4.315	4.907	5.300	6.794	7.482	7.909
1988	0.000	1.195	1.549	2.240	3.096	3.807	4.191	4.979	5.886	7.073	8.169	8.454
1989	0.000	0.880	1.313	2.095	3.068	3.885	4.491	4.869	6.012	6.334	8.911	7.133
1990	0.000	0.571	1.263	2.055	2.894	3.657	4.766	5.818	6.371	6.966	7.625	9.770
1991	0.000	0.906	1.344	2.153	2.866	3.736	4.730	5.711	6.460	6.815	8.060	9.030
1992	0.000	1.033	1.271	1.831	2.615	3.509	4.614	5.466	6.141	6.864	8.164	9.189
1993	0.000	0.761	1.110	1.666	2.312	3.143	3.754	4.723	5.492	6.704	7.704	8.131
1994	0.000	0.805	1.250	1.586	2.163	3.058	3.765	4.219	4.854	6.268	6.082	7.846
1995	0.000	0.671	1.132	1.806	2.296	3.038	3.941	4.796	5.389	7.348	8.573	8.781
1996	0.000	0.896	1.336	1.795	2.353	3.057	3.665	5.205	6.296	8.502	9.561	11.422
1997	0.000	0.915	1.388	1.938	2.446	3.288	3.976	5.101	7.763	10.058	6.737	11.915
1998	0.000	0.867	1.103	1.720	2.361	3.144	4.219	5.159	5.640	8.615	8.833	12.063
1999	0.000	0.806	1.193	1.682	2.419	3.245	4.288	5.659	7.057	9.939	9.943	10.000
2000	0.000	0.757	1.247	1.796	2.478	3.166	4.168	5.412	5.745	9.003	9.821	10.000
2001	0.105	0.453	1.039	1.987	2.929	3.734	4.775	6.532	8.118	8.539	9.026	10.788
2002	0.062	0.280	0.931	1.592	2.528	3.714	4.829	6.328	6.936	8.663	10.872	11.081
2003	0.000	0.590	0.977	1.536	2.376	3.528	4.780	6.289	7.427	9.281	10.090	8.875
2004	0.000	0.475	0.873	1.621	2.210	3.125	4.290	6.509	7.369	8.699	9.077	12.027
2005	0.000	0.391	0.862	1.392	2.054	2.749	4.015	5.202	5.755	8.866	14.277	14.277

Table 12. Small mobile age-disaggregated catch rates in the Western Component, calculated using an area-weighted approach. (Neilson et al, 2004a).

	Age3	Age4	Age5	Age6	Age7	Age8
1982	0.189	0.115	0.027	0.078	0.069	0.038
1983	0.183	0.539	0.094	0.014	0.021	0.022
1984	0.044	0.243	0.393	0.070	0.013	0.021
1985	0.019	0.068	0.215	0.247	0.035	0.003
1986	0.025	0.185	0.150	0.175	0.113	0.010
1987	0.018	0.106	0.229	0.113	0.100	0.061
1988	0.023	0.064	0.104	0.127	0.047	0.040
1989	0.000	0.000	0.000	0.000	0.000	0.000
1990	0.106	0.139	0.175	0.077	0.029	0.010
1991	0.070	0.195	0.151	0.120	0.029	0.014
1992	0.125	0.293	0.148	0.039	0.011	0.003
1993	0.055	0.214	0.183	0.068	0.015	0.005
1994	0.030	0.072	0.131	0.105	0.041	0.014
1995	0.078	0.120	0.183	0.106	0.038	0.008
1996	0.058	0.296	0.203	0.101	0.045	0.007
1997	0.024	0.142	0.243	0.086	0.020	0.003
1998	0.014	0.069	0.108	0.085	0.015	0.002
1999	0.008	0.067	0.081	0.045	0.012	0.001
2000	0.094	0.063	0.079	0.033	0.011	0.002
2001	0.054	0.123	0.063	0.029	0.007	0.001
2002	0.023	0.143	0.197	0.060	0.015	0.002
2003	0.017	0.207	0.191	0.054	0.009	0.001
2004	0.023	0.068	0.220	0.062	0.007	0.001
2005	0.004	0.131	0.112	0.160	0.011	0.001

Table 13. Summer DFO research vessel survey age - disaggregated numbers per tow (strata 474, 476 and strata 480 – 495) in the Western Component. The 2004T and 2005T represents CCGS Teleost values and the 2005N the CCGS Needler value.

	Age3	Age4	Age5	Age6	Age7	Age8
1984	0.545	0.951	3.308	0.913	0.097	0.284
1985	0.101	0.498	2.844	3.613	0.747	0.000
1986	1.468	1.929	1.599	3.027	1.821	0.072
1987	0.064	0.633	1.851	1.119	2.268	1.159
1988	1.651	2.277	6.218	5.278	4.043	1.984
1989	0.098	0.488	1.358	1.957	1.868	0.568
1990	15.197	6.864	10.383	2.456	0.619	0.755
1991	1.872	1.656	2.877	2.862	0.890	0.800
1992	0.364	0.989	1.341	1.061	0.223	0.143
1993	11.941	8.135	4.141	1.815	0.514	0.016
1994	0.301	1.086	2.306	1.980	0.784	0.219
1995	1.501	1.216	1.957	0.986	0.297	0.050
1996	1.142	12.519	10.772	3.475	1.531	0.133
1997	0.351	0.477	1.616	0.763	0.081	0.090
1998	0.126	0.306	0.616	0.609	0.143	0.000
1999	0.538	0.849	0.492	0.378	0.271	0.000
2000	0.480	0.439	0.795	0.216	0.000	0.029
2001	6.976	1.824	0.652	0.177	0.093	0.022
2002	1.583	0.731	0.580	0.200	0.106	0.024
2003	0.904	6.055	2.146	0.491	0.021	0.024
2004T	2.462	1.438	3.659	1.347	0.313	0.000
2005N	0.082	1.228	1.349	2.412	0.419	0.000
2005T	0.021	1.115	0.935	2.173	0.524	0.000

Table 14. Compared VPA estimates of population at age (bias adjusted), showing the impact of inclusion of the 2004 Teleost Indices. The top panel shows the estimates with the inclusion of the 2004 Teleost data point and the bottom panel shows the estimates without the Teleost data point. For both runs, the Mean Square Residual was 0.572.

Teleost included

	2	3	4	5	6	7	8	9	10	11	12	13	2+	3+	4+
1982	16669	20863	4658	1115	2244	1992	945	405	85	103	34	1	48114	32445	11582
1983	9117	13562	15622	2600	580	917	681	394	201	29	55	16	43975	34858	21296
1984	11568	7424	9946	9227	1363	315	469	461	199	112	9	28	41120	29552	22128
1985	7286	9467	5744	6495	5086	699	181	251	275	126	75	5	35691	28404	18937
1986	7821	5861	7575	4143	3696	2248	280	114	116	136	46	34	32173	24352	18391
1987	11229	6402	4734	4933	2372	1835	1057	150	60	62	75	26	32936	21706	15304
1988	8600	9189	5148	3310	2585	1151	600	428	62	34	37	36	31380	22780	13591
1989	12058	7024	7140	3324	1701	974	479	277	135	31	15	13	33171	21113	14089
1990	13890	9788	5402	4467	1709	676	384	260	112	52	20	6	36966	23076	13290
1991	10303	11329	7314	3432	2205	621	335	159	90	48	22	8	35866	25563	14234
1992	5773	8383	8362	4281	1464	569	200	134	80	30	17	9	29302	23529	15146
1993	5552	4685	5737	4445	2027	596	186	54	25	12	12	3	23334	17782	13097
1994	8921	4542	3339	2915	1742	643	205	70	20	11	3	5	22417	13496	8954
1995	6009	7258	3465	2127	1201	408	92	22	6	4	2	1	20615	14606	7349
1996	3955	4898	5705	2370	893	382	74	20	3	1	2	1	16306	14350	9452
1997	3518	3226	3828	3816	1303	310	86	13	3	3	1	1	16107	12590	9364
1998	3362	2876	2505	2325	1646	374	62	23	7	3	1	1	13185	9822	6946
1999	5914	2747	2149	1307	688	238	38	10	5	4	1	1	13102	7187	4441
2000	6960	4831	2168	1314	516	185	43	11	4	3	1	1	16036	9077	4247
2001	12179	5621	3431	1412	547	140	29	11	4	3	2	1	23379	11201	5580
2002	4841	9958	4300	2078	645	168	34	12	5	1	1	1	22043	17202	7244
2003	7610	3957	7980	2812	745	159	26	10	4	3	1	1	23309	15699	11742
2004	656	6229	3139	5361	1114	156	25	5	4	2	1	1	16695	16039	9810
2005	5000	535	4944	2082	2758	295	24	9	1	1	1	1	15602	10602	10067
2005.67	4373	441	3608	1252	1410	135	11	4	1	1	1	1	11237	6864	6423

No Teleost Data Point

	2	3	4	5	6	7	8	9	10	11	12	13	2+	3+	4+
1982	16669	20863	4658	1115	2244	1992	945	405	85	103	34	1	48114	32445	11582
1983	9117	13562	15622	2600	580	917	681	394	201	29	55	16	43975	34858	21296
1984	11568	7424	9946	9227	1363	315	469	461	199	112	9	28	41120	29552	22128
1985	7286	9467	5744	6495	5086	699	181	251	275	126	75	5	35691	28404	18937
1986	7821	5861	7575	4143	3696	2248	280	114	116	136	46	34	32173	24352	18391
1987	11229	6402	4734	4933	2372	1835	1057	150	60	62	75	26	32936	21706	15304
1988	8600	9189	5148	3310	2585	1151	600	428	62	34	37	36	31380	22780	13591
1989	12058	7024	7140	3324	1701	974	479	277	135	31	15	13	33171	21113	14089
1990	13890	9788	5402	4467	1709	676	384	260	112	52	20	6	36966	23076	13290
1991	10303	11329	7314	3432	2205	621	335	159	90	48	22	8	35866	25563	14234
1992	5773	8383	8362	4281	1464	569	200	134	80	30	17	9	29302	23529	15146
1993	5552	4685	5737	4445	2027	596	186	54	25	12	12	3	23334	17782	13097
1994	8921	4542	3339	2915	1742	643	205	70	20	11	3	5	22417	13496	8954
1995	6009	7258	3465	2127	1201	408	92	22	6	4	2	1	20615	14606	7349
1996	3955	4898	5705	2370	893	382	74	20	3	1	2	1	16306	14350	9452
1997	3518	3226	3828	3816	1303	310	86	13	3	3	1	1	16107	12590	9364
1998	3359	2875	2505	2325	1646	374	62	23	7	3	1	1	13180	9821	6946
1999	5886	2744	2148	1307	688	238	38	10	5	4	1	1	13069	7183	4440
2000	6802	4807	2166	1313	516	185	43	11	4	3	1	1	15952	9050	4243
2001	12146	5573	3412	1410	546	140	29	11	4	3	2	1	23277	11131	5558
2002	4512	9931	4261	2062	643	168	34	12	5	1	1	1	21631	17118	7187
2003	5719	3688	7958	2780	732	158	26	10	4	3	1	1	21081	15361	11673
2004	682	4681	2919	5344	1088	146	24	5	4	2	1	1	14898	14216	9535
2005	5000	557	3676	1902	2694	274	16	8	1	1	1	1	14132	9132	8575
2005.67	4373	460	2500	1095	1397	116	4	3	1	1	1	1	9952	5579	5120

Table 15. ADAPT results – population numbers, bias adjusted for pollock in the Western Component.

	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13
1982	16669	20863	4658	1115	2244	1992	945	405	85	103	34	1
1983	9117	13562	15622	2600	580	917	881	394	201	29	55	16
1984	11568	7424	9946	9227	1363	315	469	461	199	112	9	28
1985	7286	9467	5744	6495	5086	699	181	251	275	126	75	5
1986	7821	5961	7575	4143	3696	2248	280	114	116	136	48	34
1987	11229	6402	4734	4933	2372	1835	1057	150	60	62	75	26
1988	8600	9189	5148	3310	2585	1151	800	428	62	34	37	36
1989	12058	7024	7140	3324	1701	974	479	277	135	31	15	13
1990	13890	9788	5402	4467	1709	876	384	260	112	52	20	6
1991	10303	11329	7314	3432	2205	621	335	159	90	48	22	8
1992	5773	8383	8362	4281	1464	569	200	134	80	30	17	9
1993	5552	4685	5737	4445	2027	596	186	54	25	12	12	3
1994	8921	4542	3339	2915	1742	643	205	70	20	11	3	5
1995	6009	7258	3485	2127	1201	408	92	22	6	4	2	1
1996	3955	4898	5705	2370	893	382	74	20	3	1	2	1
1997	3520	3226	3828	3816	1303	310	86	13	3	3	1	1
1998	3363	2876	2505	2325	1646	374	62	23	7	3	1	1
1999	5922	2747	2149	1307	688	238	38	10	5	4	1	1
2000	6955	4837	2169	1314	516	185	43	11	4	3	1	1
2001	12278	5616	3436	1412	547	140	29	11	4	3	2	1
2002	4834	10039	4296	2082	645	169	34	12	5	1	1	1
2003	7775	3951	8047	2809	748	160	26	10	4	3	1	1
2004	627	6364	3135	5416	1112	159	25	6	4	2	1	1
2005	5000	512	5054	2079	2752	292	26	9	1	1	1	1
2005.67	4373	420	3705	1248	1447	132	13	4	1	1	1	1

Table 16. ADAPT results (consensus formulation) – Bias adjusted fishing mortality at age estimates, Western Component pollock.

	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	4-9 F	6-9 F	Landings
1982	0.006	0.089	0.383	0.453	0.695	0.615	0.675	0.498	0.863	0.431	0.538	0.000	0.521	0.649	18347
1983	0.005	0.110	0.327	0.446	0.413	0.470	0.449	0.484	0.387	0.996	0.477	0.000	0.358	0.453	16448
1984	0.000	0.057	0.226	0.396	0.467	0.352	0.424	0.317	0.257	0.207	0.285	0.000	0.321	0.419	15291
1985	0.001	0.023	0.127	0.364	0.616	0.716	0.262	0.571	0.502	0.769	0.580	0.000	0.375	0.615	19511
1986	0.000	0.030	0.229	0.358	0.500	0.555	0.423	0.439	0.429	0.401	0.421	0.000	0.359	0.515	17520
1987	0.000	0.018	0.158	0.446	0.523	0.630	0.705	0.682	0.370	0.309	0.528	0.000	0.411	0.599	16460
1988	0.002	0.052	0.237	0.466	0.776	0.677	0.860	0.954	0.490	0.596	0.875	0.000	0.495	0.782	17899
1989	0.009	0.062	0.269	0.465	0.463	0.731	0.410	0.708	0.745	0.238	0.686	0.000	0.386	0.552	13724
1990	0.004	0.091	0.254	0.506	0.812	0.762	0.682	0.860	0.651	0.651	0.779	0.000	0.471	0.787	15595
1991	0.006	0.104	0.336	0.652	1.155	0.934	0.716	0.488	0.894	0.843	0.668	0.000	0.578	1.038	18602
1992	0.009	0.179	0.432	0.548	0.699	0.916	1.115	1.481	1.717	0.705	1.462	0.000	0.528	0.831	16639
1993	0.001	0.139	0.477	0.736	0.948	0.869	0.773	0.793	0.577	1.041	0.766	0.000	0.662	0.917	14410
1994	0.006	0.065	0.251	0.686	1.253	1.740	2.025	2.238	1.423	1.400	1.021	0.000	0.753	1.456	10836
1995	0.004	0.041	0.186	0.667	0.945	1.500	1.332	1.746	1.216	0.328	0.639	0.000	0.542	1.107	7144
1996	0.004	0.047	0.202	0.398	0.858	1.287	1.582	1.645	0.000	0.000	0.639	0.000	0.371	1.029	6441
1997	0.002	0.053	0.299	0.641	1.048	1.407	1.131	0.430	0.000	0.550	0.000	0.000	0.587	1.112	9759
1998	0.002	0.091	0.450	1.018	1.732	2.092	1.672	1.412	0.398	0.550	0.000	0.000	1.047	1.791	10534
1999	0.002	0.036	0.292	0.729	1.112	1.521	0.998	0.610	0.276	0.899	0.000	0.000	0.621	1.202	4760
2000	0.014	0.142	0.229	0.677	1.108	1.641	1.157	0.848	0.298	0.000	0.000	0.000	0.548	1.237	4768
2001	0.001	0.068	0.301	0.583	0.977	1.222	0.732	0.687	0.786	0.550	0.639	0.000	0.465	1.010	5400
2002	0.001	0.021	0.224	0.823	1.196	1.659	1.034	0.829	0.278	0.000	0.000	0.000	0.521	1.276	6485
2003	0.000	0.029	0.190	0.720	1.341	1.638	1.343	0.810	0.308	0.496	0.000	0.000	0.412	1.385	7839
2004	0.002	0.026	0.194	0.449	1.078	1.490	0.787	1.401	0.938	0.578	0.000	0.000	0.457	1.124	8012
2005	0.000	0.052	0.216	0.473	0.648	0.779	0.511	0.783	0.000	0.000	0.000	0.000	0.402	0.660	5806

Table 17. ADAPT results (consensus formulation) – Bias-adjusted biomass (t) trends at age estimates. Western Component pollock.

	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	2+	3+	4+
1982	4726	16919	7886	3332	8570	8928	4920	2409	586	840	327	10	59453	54727	37808
1983	2761	16748	25936	7670	2256	4251	4576	2417	1351	235	480	163	68844	66083	49335
1984	4162	7006	26010	25190	5057	1527	2610	2728	1321	808	80	279	76777	72615	65610
1985	2350	7632	13217	18831	16946	2927	1033	1674	1834	917	612	54	68028	65679	58047
1986	3311	5361	12177	12994	13041	9198	1395	722	842	988	398	342	60767	57456	52096
1987	2076	4108	8916	12599	7878	7557	4982	832	405	454	568	257	50632	48556	44447
1988	4918	6391	7021	8951	8801	4450	3708	2298	381	254	297	361	47830	42912	36521
1989	4417	5268	13570	8934	5899	4025	2164	1517	824	248	117	127	47110	42693	37425
1990	3519	6427	7146	12435	5726	3770	1962	1449	724	365	188	63	43774	40255	33828
1991	3770	6685	8440	8293	7251	2584	1746	974	594	358	186	76	40955	37185	30500
1992	1910	6503	11492	8522	4642	2361	1017	793	532	225	145	94	38236	36326	29823
1993	2465	2622	6704	9788	5813	2162	869	294	160	85	100	32	31094	28629	26007
1994	2765	3149	3698	4713	4633	2213	814	337	117	73	26	47	22584	19820	16671
1995	1277	3496	4125	4183	3079	1415	393	105	37	29	17	10	18166	16889	13393
1996	791	3003	5943	4622	2367	1275	337	110	21	13	23	10	18515	17724	14721
1997	719	3141	5127	8024	3625	1081	373	80	25	20	13	10	22237	21518	18377
1998	1262	1739	2432	4688	4565	1394	282	122	55	24	11	10	16584	15323	13583
1999	1311	1668	2559	2390	1904	875	185	58	34	34	11	10	11040	9729	8061
2000	1833	3372	2620	2414	1429	682	205	65	34	28	12	10	12704	10871	7499
2001	3850	2948	5084	3322	1663	543	153	73	28	23	24	10	17721	13871	10923
2002	1246	6071	5038	4402	2128	716	185	78	38	14	12	10	19938	18692	12622
2003	1713	2799	9455	5901	2234	673	145	67	33	26	12	10	23068	21355	18556
2004	129	3603	4481	10324	3029	619	140	38	29	23	15	10	22440	22312	18708
2005	1335	305	6280	3929	6784	1036	124	55	8	13	13	11	19893	18558	18252

Table 18. Statistical properties of estimates of population abundance (numbers in 000's) at time 2005.25 and survey calibration constants (unitless, survey: population) for pollock in the Western Component obtained from a bootstrap with 500 replications.

Age	Estimate	Standard Error	Relative Error	Bias	Relative Bias
		Population Abundance (000 s)			
3	534	708	1.327	113	0.212
4	3960	2036	0.514	255	0.064
5	1367	677	0.495	119	0.087
6	1590	878	0.553	143	0.090
7	160	116	0.728	28	0.173
8	16	16	1.012	3	0.189

Age	Estimate	Standard Error	Relative Error	Bias	Relative Bias
		Survey Calibration Constants			
3	0.00015	0.00002	0.16000	0.00000	0.03000
4	0.00036	0.00006	0.15600	0.00000	0.00900
5	0.00092	0.00015	0.15700	0.00002	0.01600
6	0.00139	0.00022	0.16200	0.00000	0.00200
7	0.00166	0.00027	0.16100	0.00000	0.00200
8	0.00151	0.00027	0.18100	0.00003	0.01800

Age	Estimate	Standard Error	Relative Error	Bias	Relative Bias
		CPUE Calibration Constants			
3	0.00001	0.00031	51.172	0.00006	10.083
4	0.00005	0.10087	2147.484	0.00617	131.353
5	0.00051	0.02368	46.150	0.00378	7.362
6	0.00069	0.01393	20.291	0.00219	3.196
7	0.00062	0.00083	1.336	0.00027	0.440
8	0.00012	0.00009	0.767	0.00002	0.181

Age	Estimate	Standard Error	Relative Error	Bias	Relative Bias
		CPUE Power Coefficients			
3	1.01805	0.26076	0.256	-0.01090	-0.011
4	0.96133	0.31395	0.327	-0.01591	-0.017
5	0.73771	0.25718	0.349	0.00357	0.005
6	0.70049	0.23543	0.336	0.01721	0.025
7	0.64933	0.15095	0.232	-0.00247	-0.004
8	0.87518	0.11723	0.134	-0.00178	-0.002

Table 19. Input parameters for pollock projections in the Western Component for the 2005/06 fishery.

Year	Age Group											
	2	3	4	5	6	7	8	9	10	11	12	13
Population Numbers (000s)												
2005.67	4373	420	3705	1248	1447	132	13	4	1	1	1	1
Partial Recruitment to the Fishery												
2005.67	0.001	0.043	0.175	0.435	0.766	1.000	0.778	0.807	0.250	0.216	0.000	0.000
2006.25	0.001	0.043	0.175	0.435	0.766	1.000	0.778	0.807	0.250	0.216	0.000	0.000
Weight at beginning of year for population (kg)												
2005.67	0.231	0.624	1.282	1.966	2.725	3.882	5.271	6.595	8.048	9.891	10.741	10.000
2006.25	0.231	0.624	1.282	1.966	2.725	3.882	5.271	6.595	8.048	9.891	10.741	10.000
2007.25	0.231	0.624	1.282	1.966	2.725	3.882	5.271	6.595	8.048	9.891	10.741	10.000
Weight at age for catch (kg)												
2005.67	0.485	0.904	1.517	2.213	3.134	4.362	6.000	6.850	8.949	11.148	11.726	11.000
2006.25	0.485	0.904	1.517	2.213	3.134	4.362	6.000	6.850	8.949	11.148	11.726	11.000
Maturity												
2005.67	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2006.25	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2007.25	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

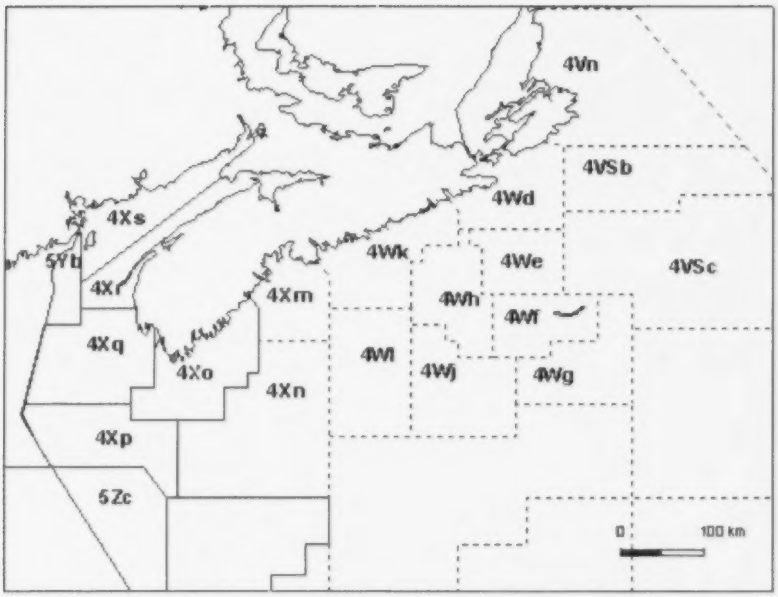


Fig. 1. DFO Statistical Unit Areas in the Scotian Shelf and Bay of Fundy and NAFO SubDivision 5Zc. Those areas forming the Western Component of pollock on the Scotian Shelf, Bay of Fundy and Georges Bank are outlined as solid lines, and those comprising the Eastern Component are shown dashed lines.

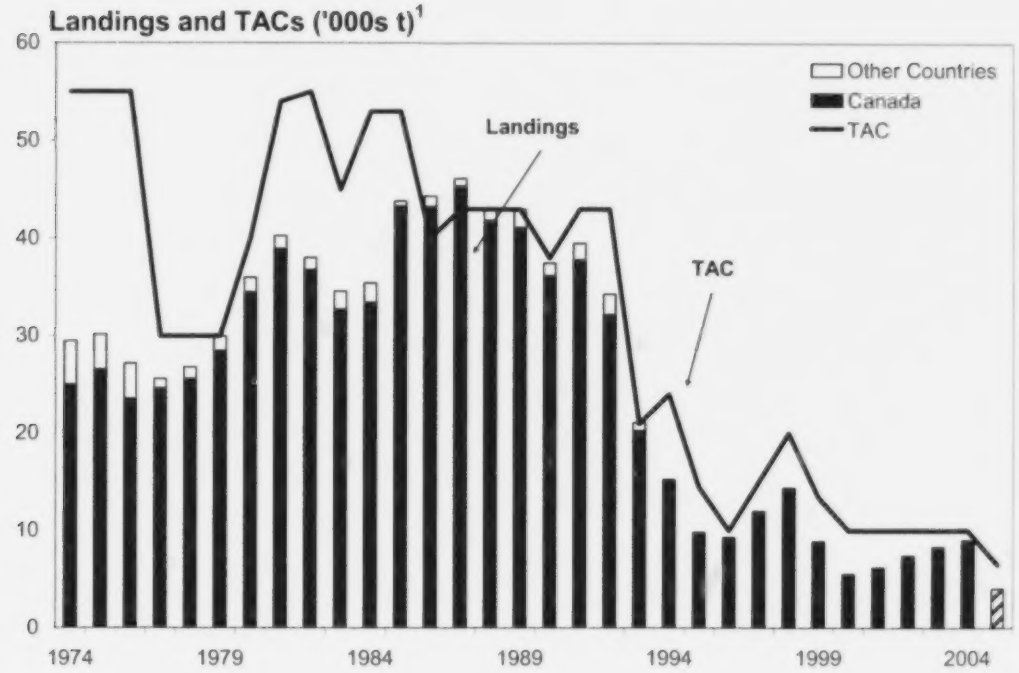


Fig. 2. Landings of 4VWX5Zc pollock, shown with respect to the Total Allowable Catch (TAC). The striped bar in 2005 signifies incomplete landings to August 31. Prior to 1999, the quota year was Jan. 1 to Dec. 31. In 1999, the quota year was Jan. 1, 1999 to Mar. 31, 2000. Subsequently, it is Apr 1 to Mar. 31. All landings are shown for quota years.

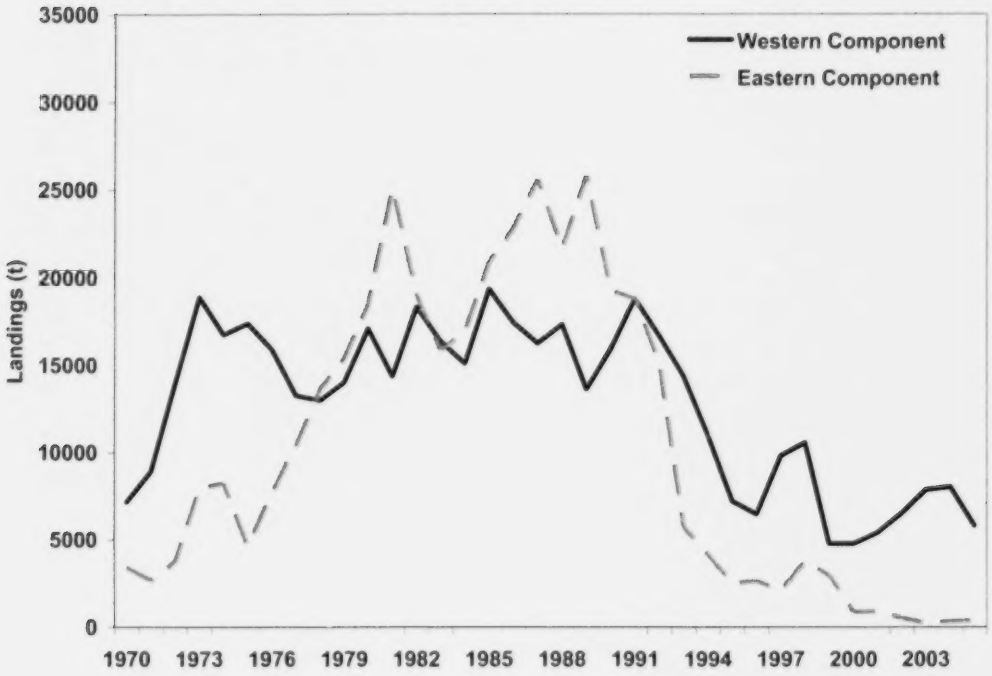


Fig. 3. Landings of pollock from the Eastern and Western Components, 1970-2005.

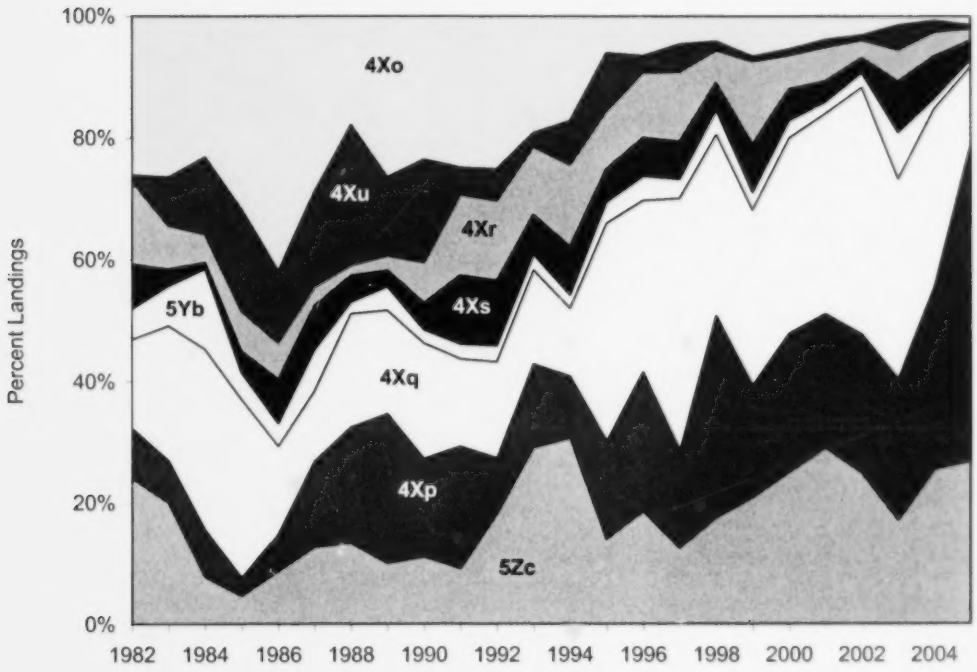


Fig. 4. Proportional calendar year landings of pollock by statistical Unit Area, 1982-2005 (Western Component).

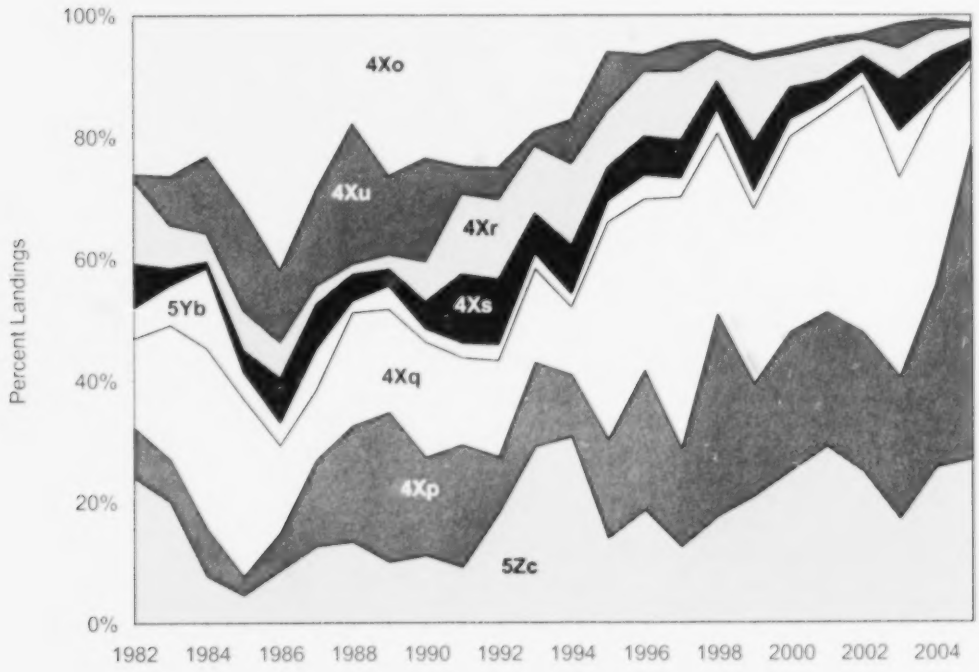


Fig. 4. Proportional calendar year landings of pollock by statistical Unit Area, 1982-2005 (Western Component).

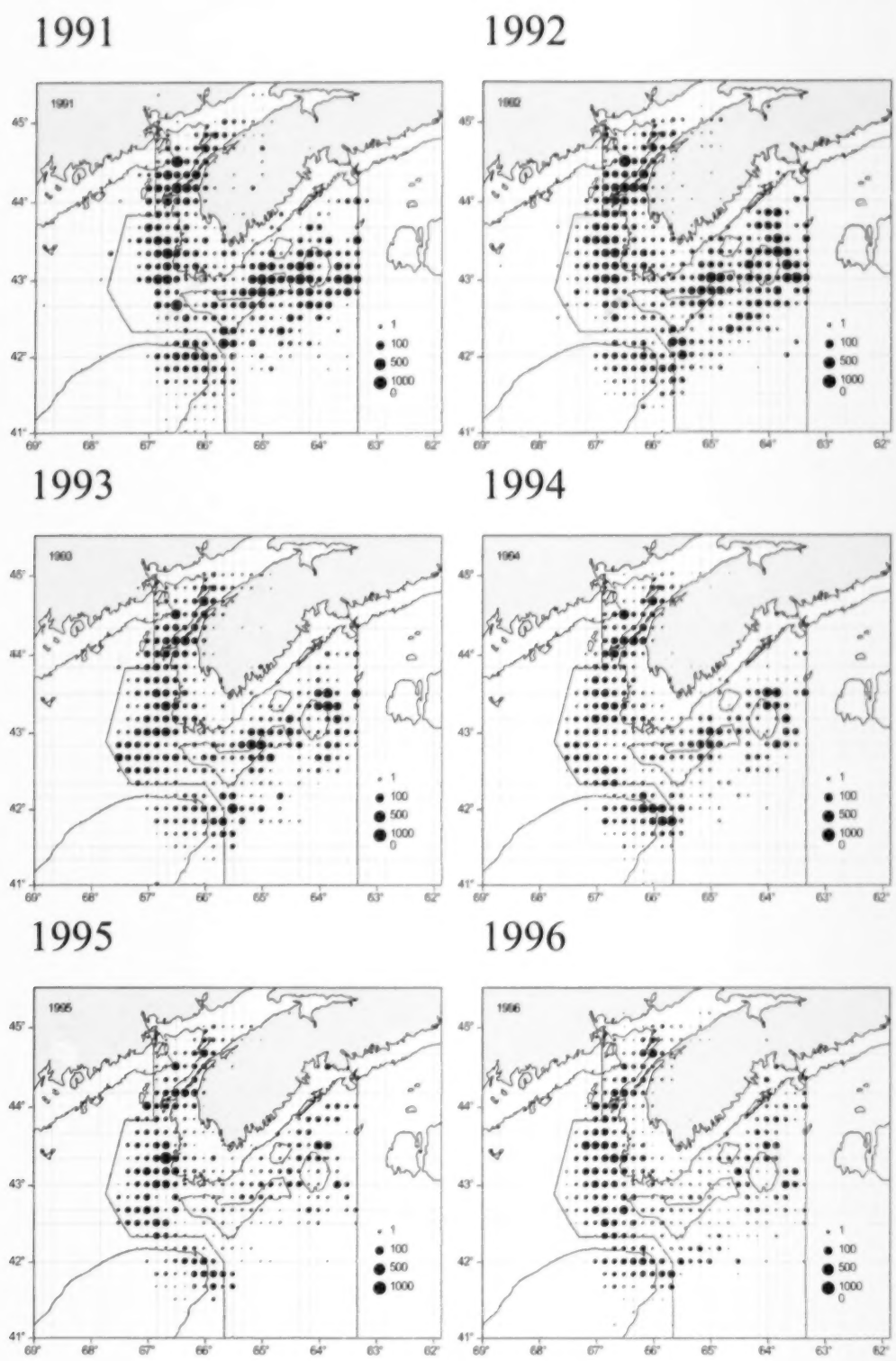


Fig. 5. Spatial distribution of pollock catches by small mobile otter trawl (TC 1-3) in 4X, summarized by 10 minute grid cells from 1991-1996 showing the gradual constriction in area where pollock is caught.

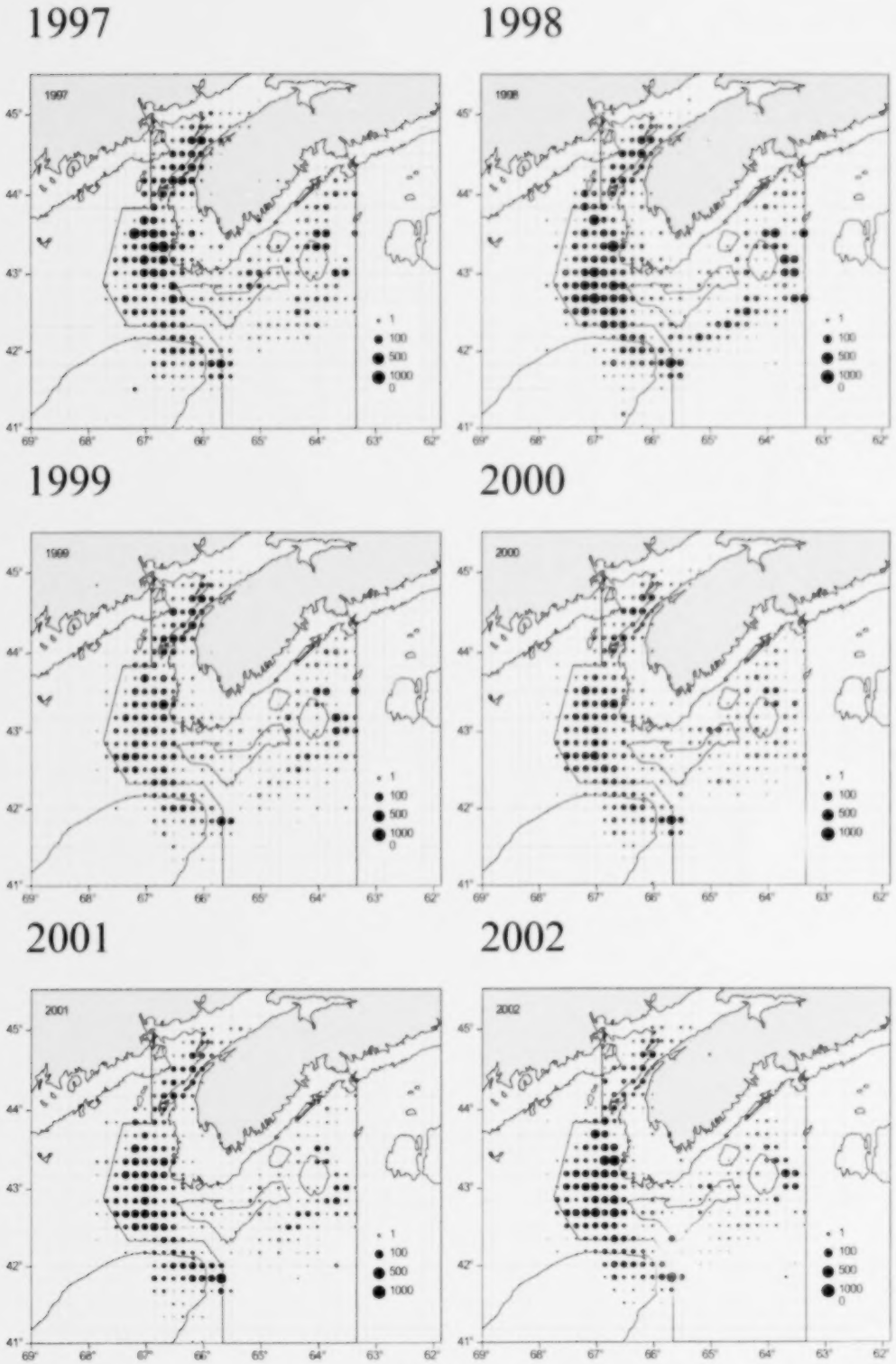
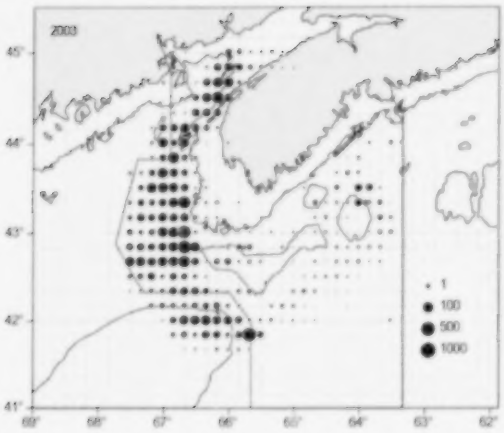
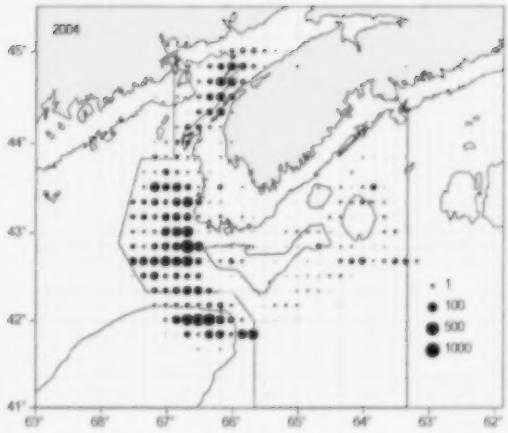


Fig. 5(cont). Spatial distribution of pollock catches by small mobile otter trawl (TC 1-3) in 4X, summarized by 10 minute grid cells from 1997-2002 showing the gradual constriction in area where pollock is caught.

2003



2004



2005

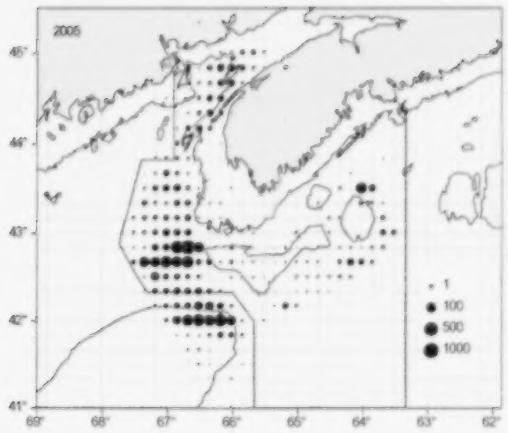


Fig. 5 (cont). Spatial distribution of pollock catches by small mobile otter trawl (TC 1-3) in 4X, summarized by 10 minute grid cells from 2003-2005 showing the gradual constriction in area where pollock is caught

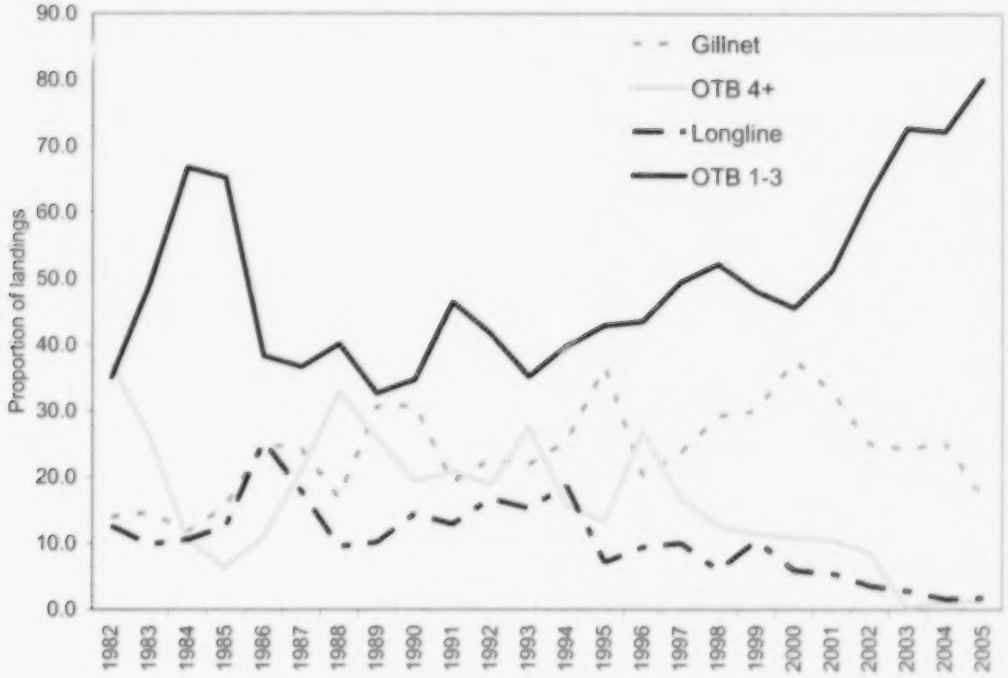


Fig. 6. Proportional landings of pollock by gear type, (Western Component) 1982 - 2005.

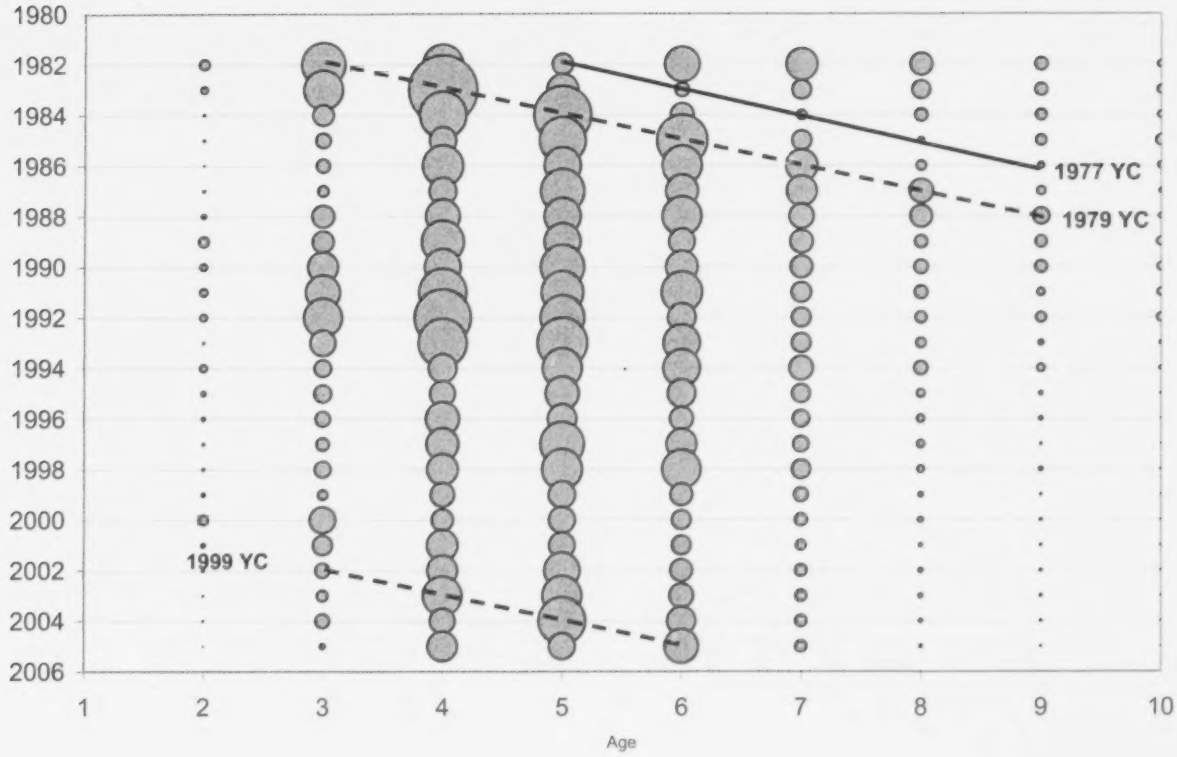


Fig. 7. Catch at age for pollock in the Western Component. The area of the circle is proportional to the catch at that age and year. Two examples of strong cohorts are highlighted with a dashed line, and a weak cohort is indicated by the solid line.

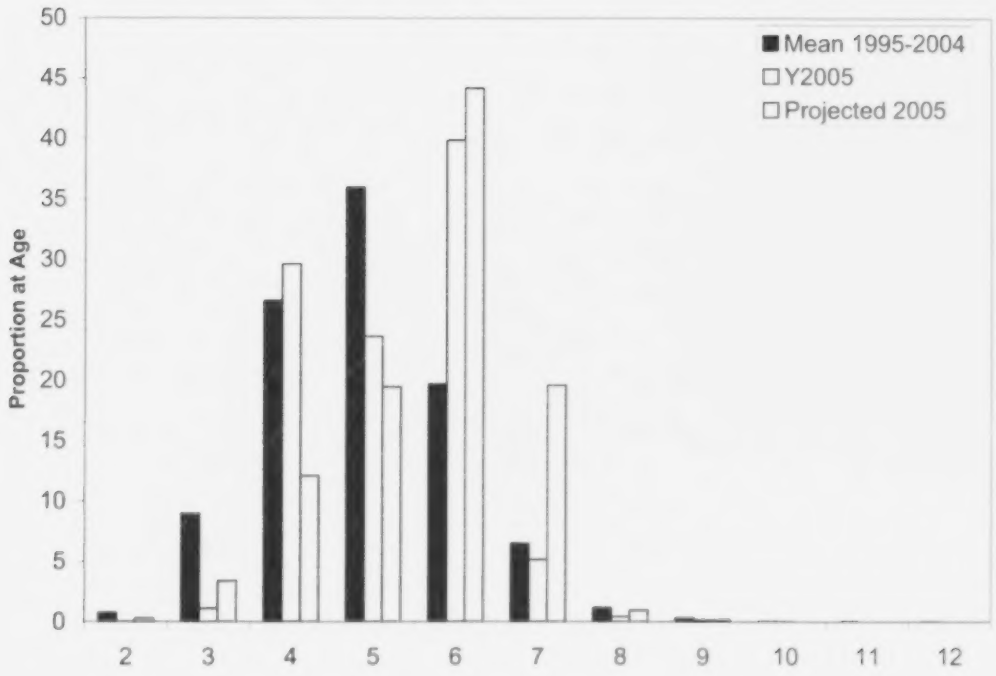


Fig. 8. Age composition of Western Component pollock catch in 2005 compared with the 10 year average from 1995-2004 as well as the projected catch for 2005.

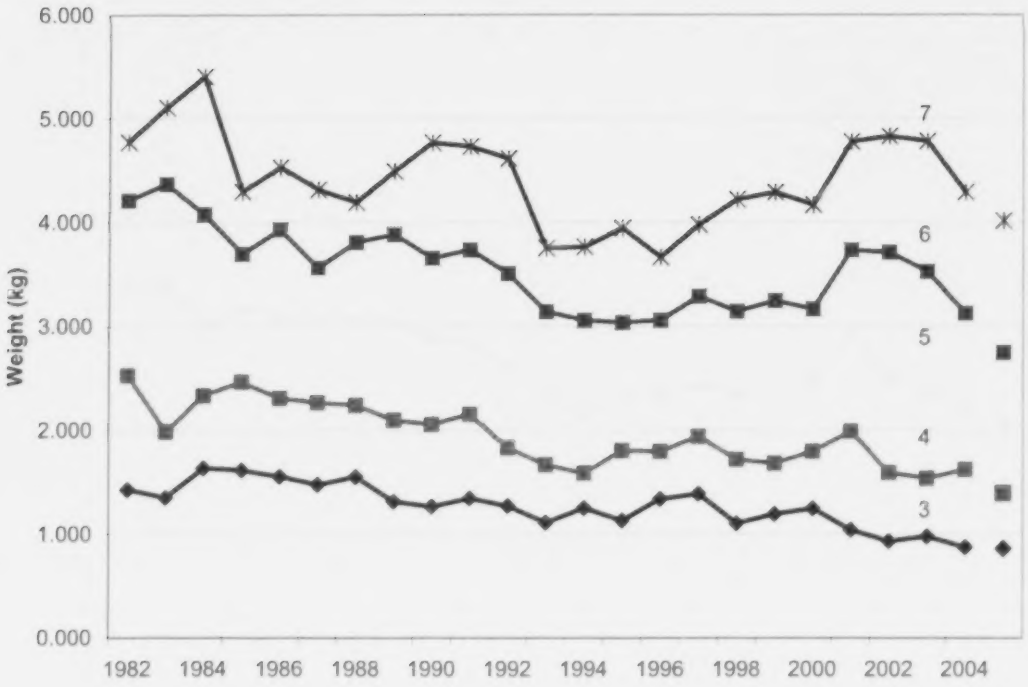


Fig. 9. Trends in mean weight at age (kg) for pollock of ages 3-7 in the Western Component from the commercial fishery. The weights at age for the partial year 2005 are signified by the point.

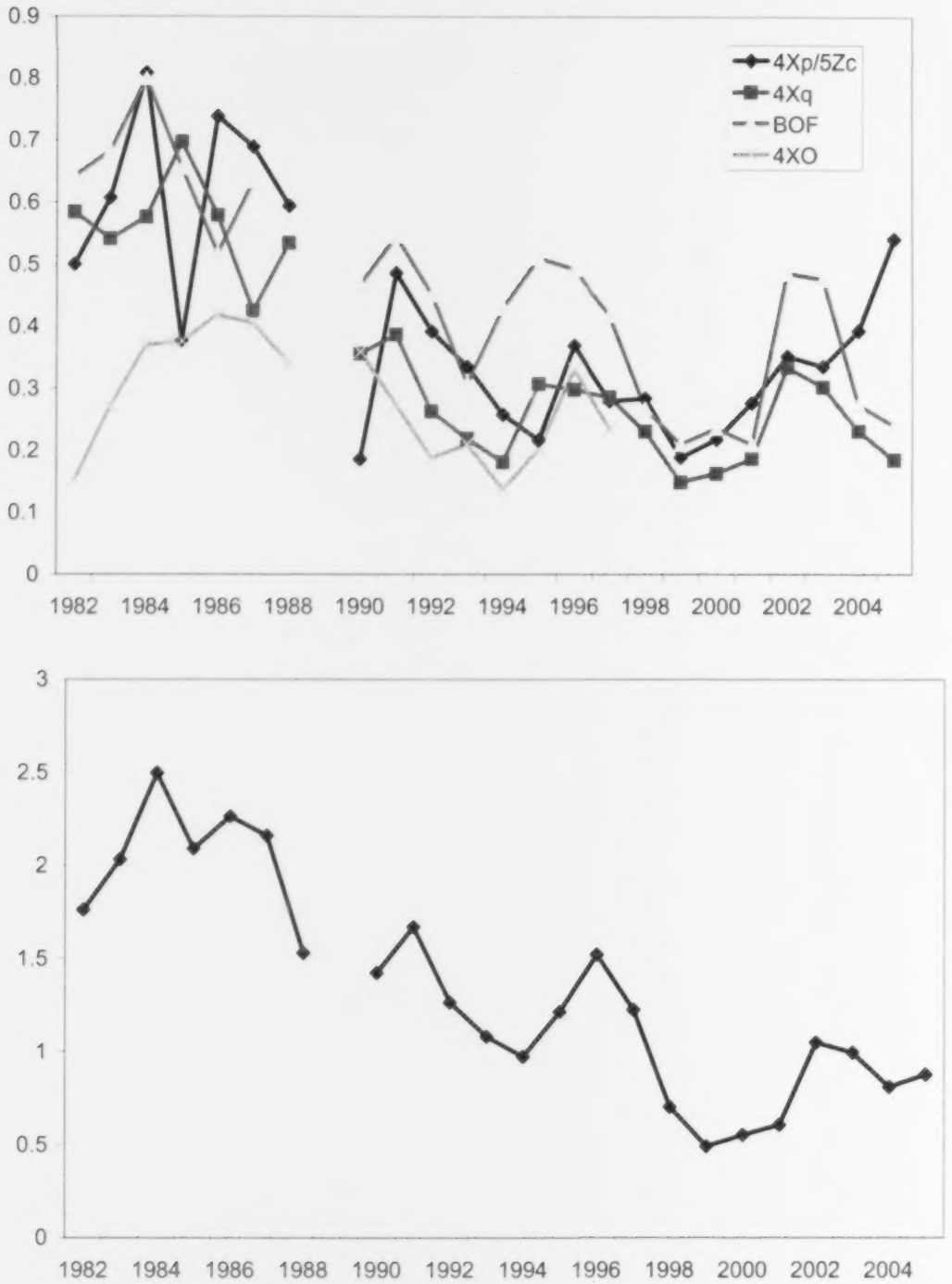


Fig. 10. Standardized mobile gear (TC 2-3) catch rate series (t/hr) for pollock for the Western Component from 1982-2005. The top panel is the catch rate series by NAFO Unit area and the bottom panel is the area weighted catch rate series.

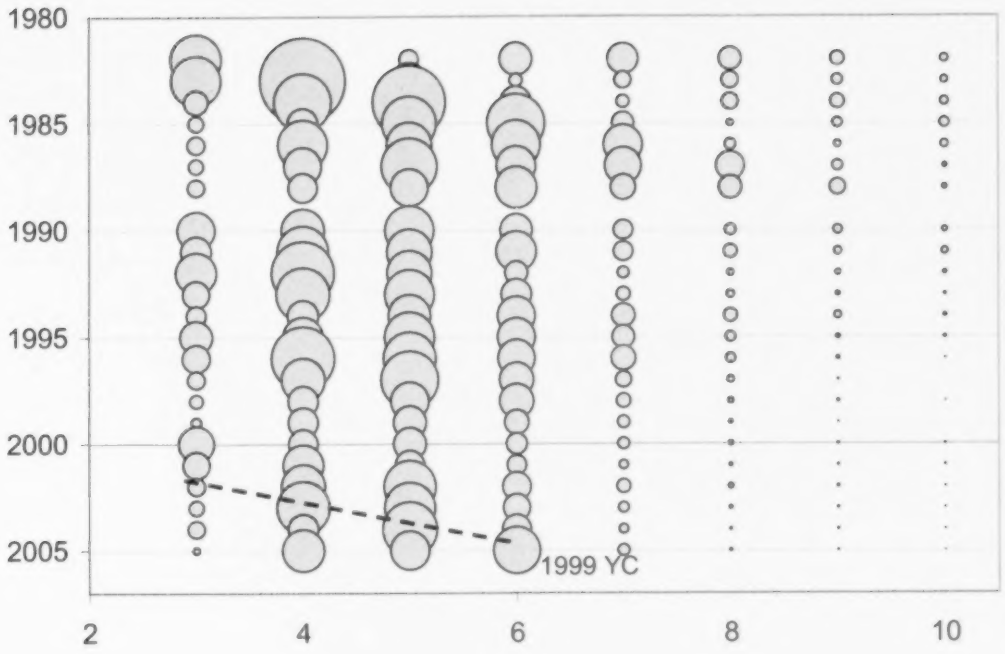


Fig. 11. Age-disaggregated catch rates for small mobile gear operating in the Western Component, 1982 – 2005.

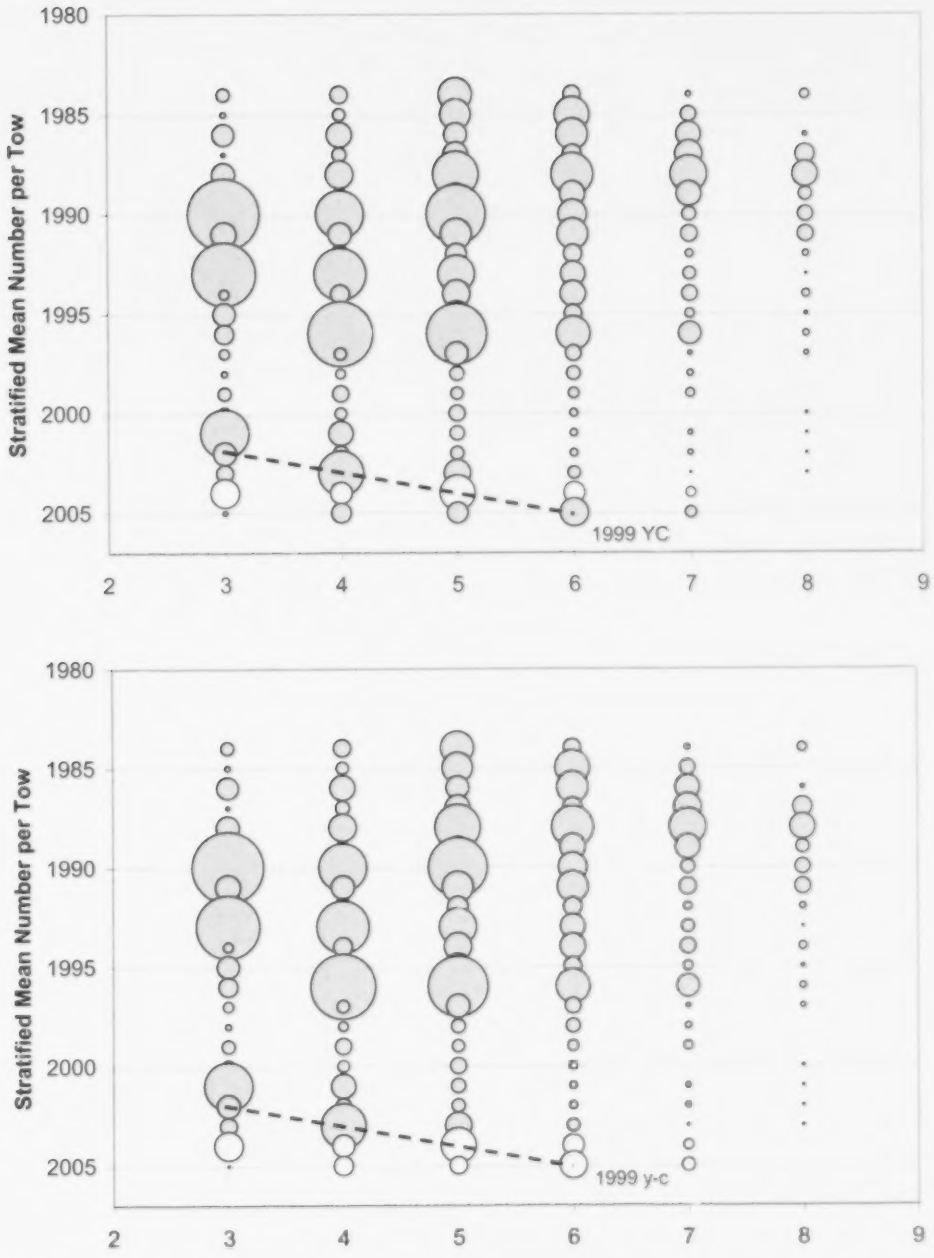


Fig. 12. Stratified mean number per tow at age of pollock from the DFO summer research vessel survey in 4X (strata 474, 476 and 480-485) corresponding to the Western Component, 1984-2005. The top panel show Needler survey data with Teleost data point in 2004 shown as an open circle. The bottom panel shows Needler survey data from 1984-2003 and Teleost data as open circles for 2004-2005.

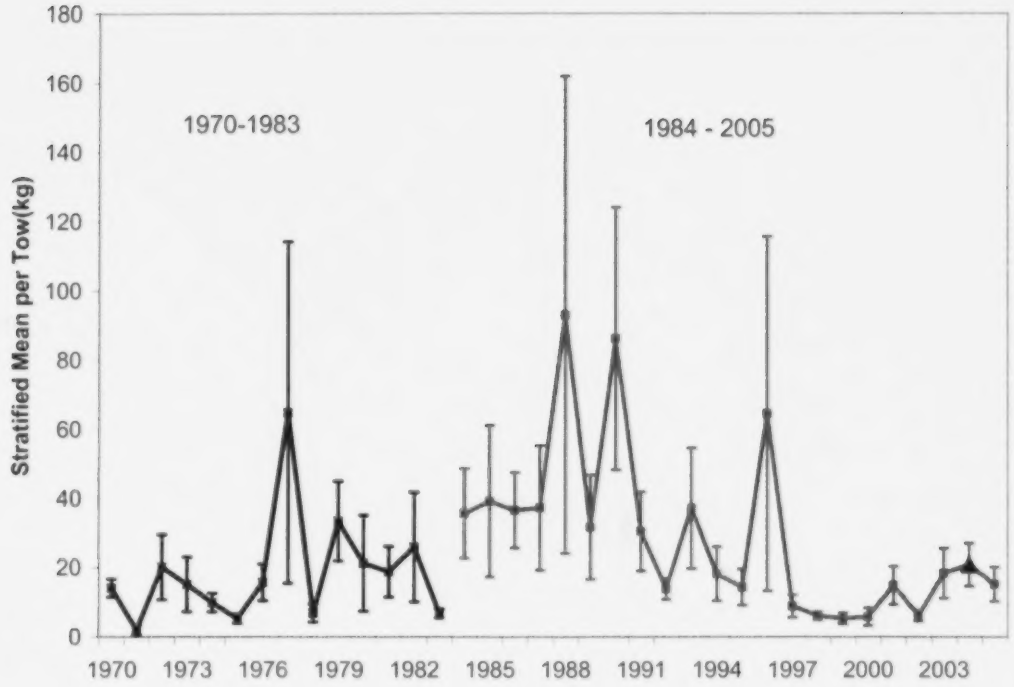


Fig. 13. Stratified mean catch per tow (kg) of pollock from the DFO summer research vessel survey in 4X strata (strata 474, 476 and 480-495) corresponding to the Western Component, 1970-2005. Data from 1984 until the present is the input data used in the VPA. The different symbol signifies a change in research vessel for 2004 only.

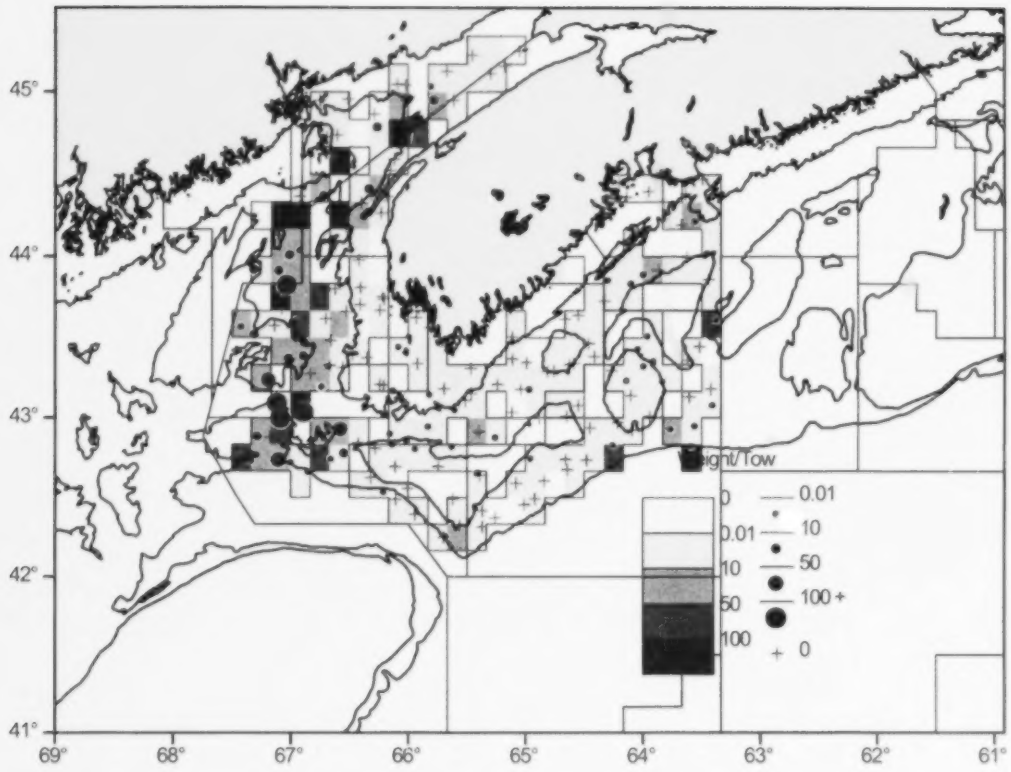


Fig. 14. 2005 ITQ survey pollock catches, shown with respect to the average catch for the years 1996-2004.

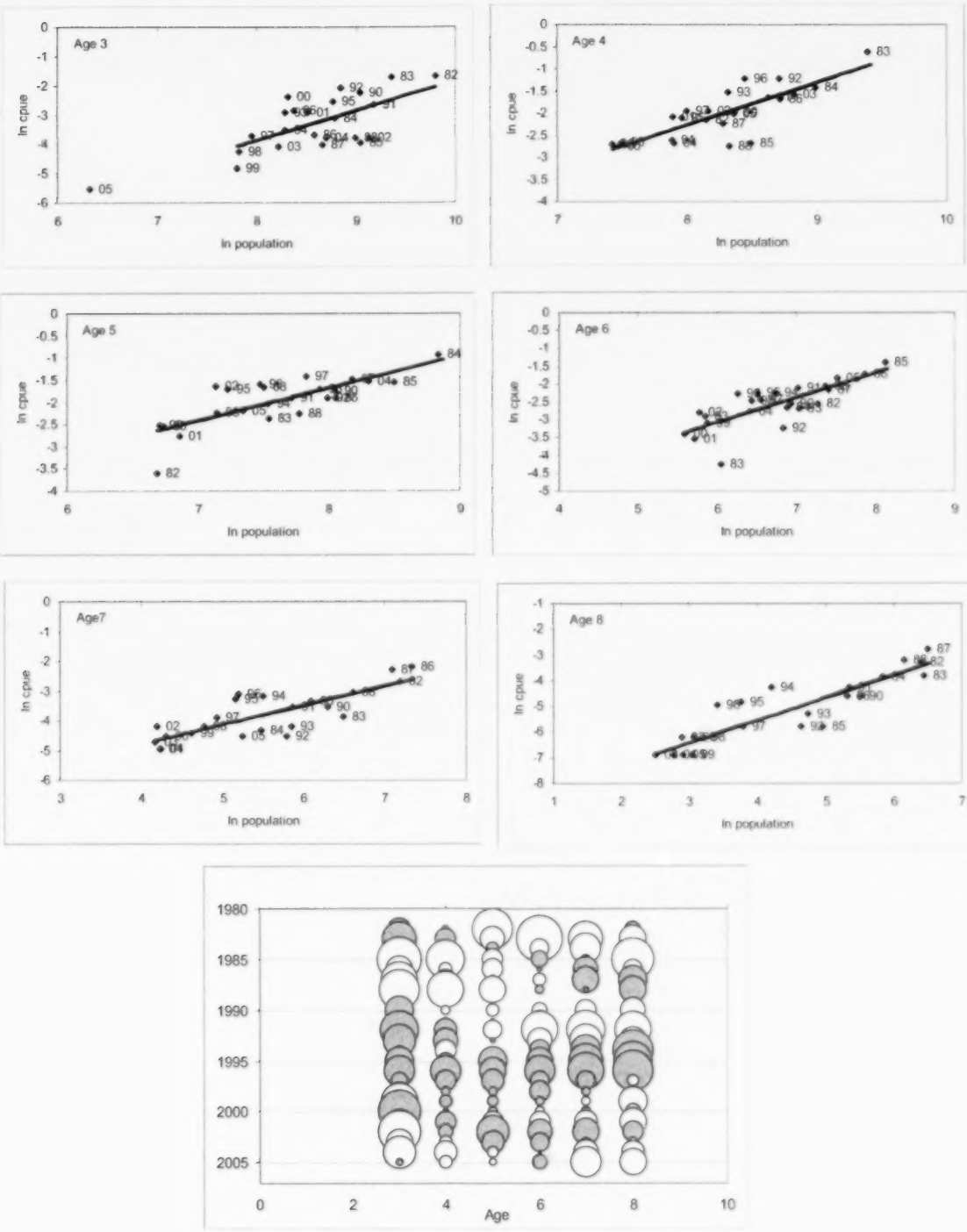


Fig. 15. Age-specific relationships between the small mobile gear indices (y axis) and population (x axis) on a ln scale, and the resulting residuals at age (bottom figure). Consensus formulation, Western Component pollock. Closed circles denote positive residuals and open circles denote negative residuals, size of circle is relative to magnitude.

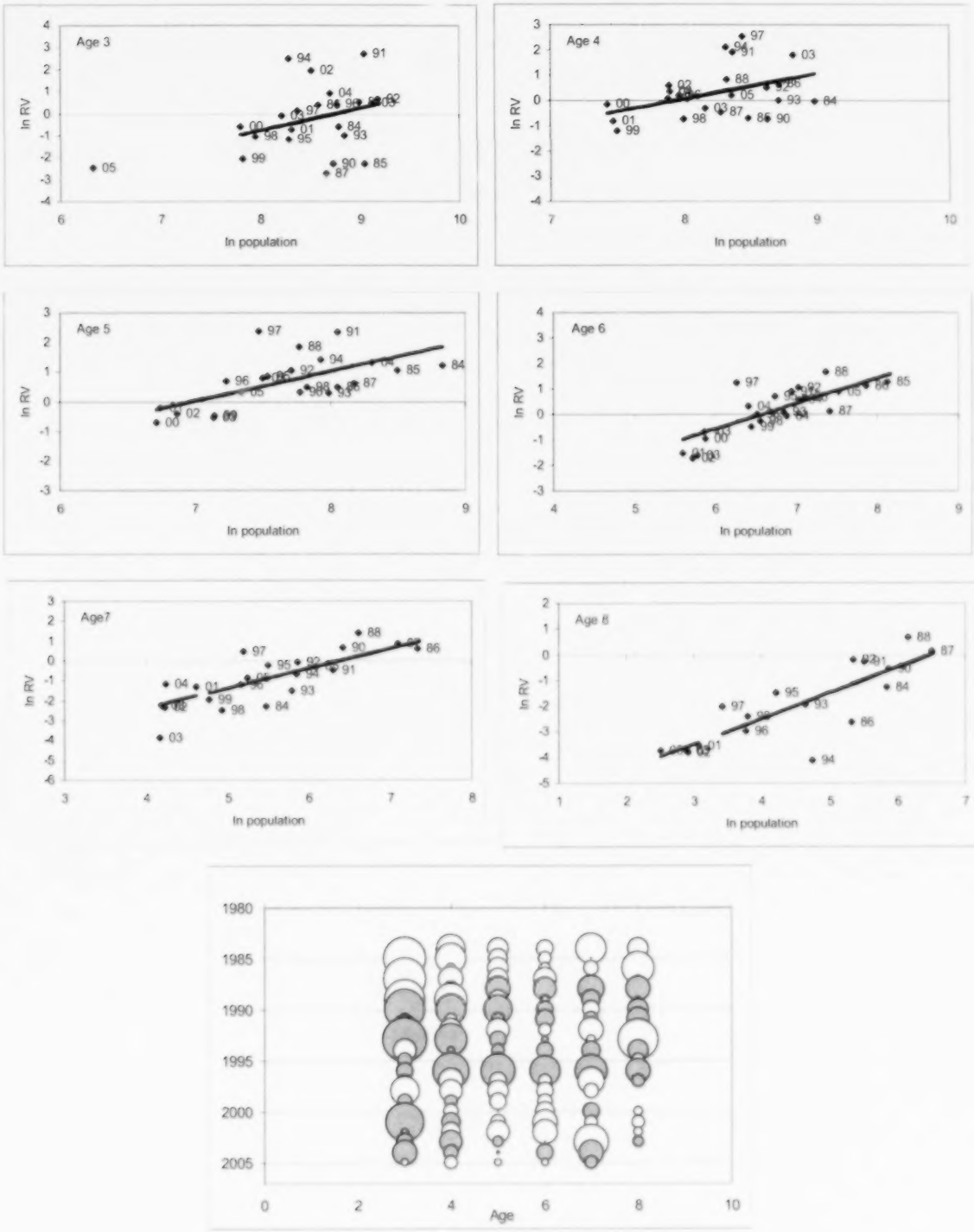


Fig. 16. Age-specific relationships between the RV indices (y axis) and population (x axis), and the resulting residuals at age (bottom right figure). Consensus formulation, Western Component pollock. Closed circles denote positive residuals and open circles denote negative residuals, size of circle is relative to magnitude.

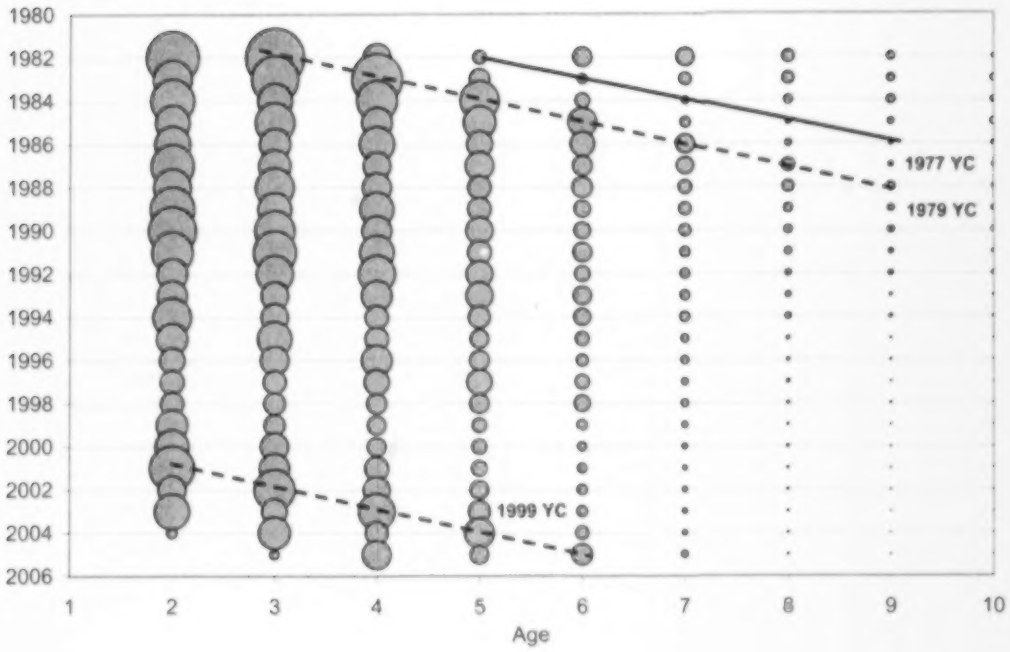


Fig. 17. Population numbers at age for the Western Component of pollock. Examples of the strong 1977 and 1999 year-classes are highlighted with the dashed lines while the weak 1977 year-class is highlighted with a solid line.

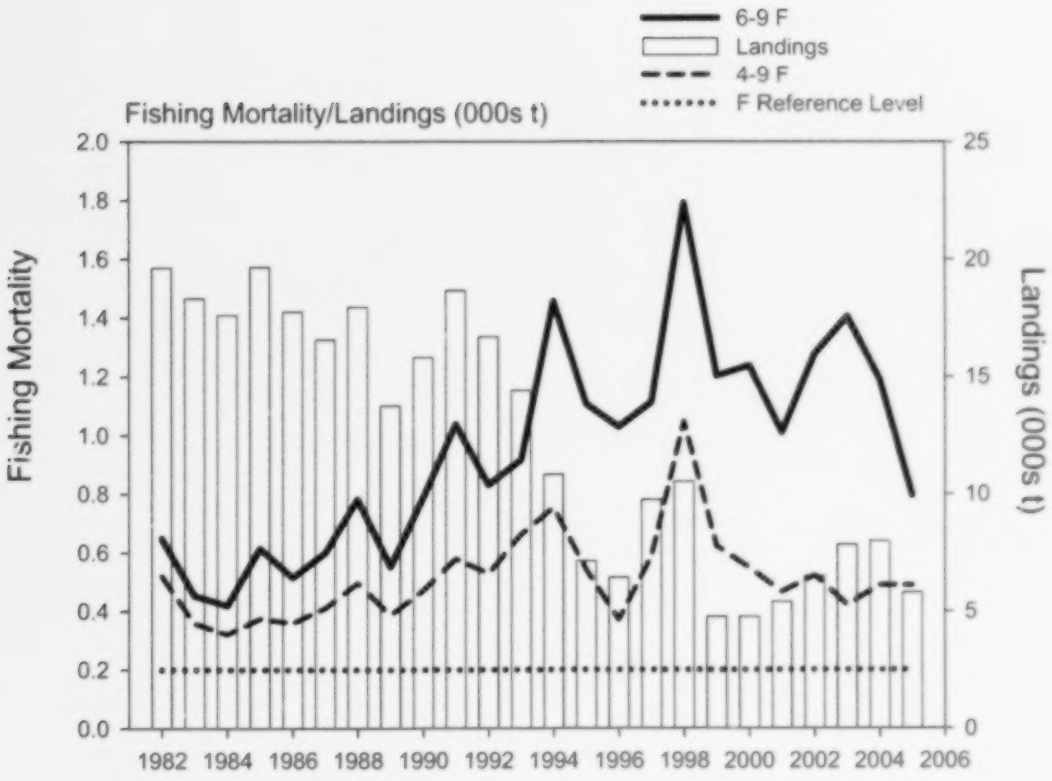


Fig. 18. Trends in fishing mortality for the Western Component of pollock as indicated by the consensus formulation.

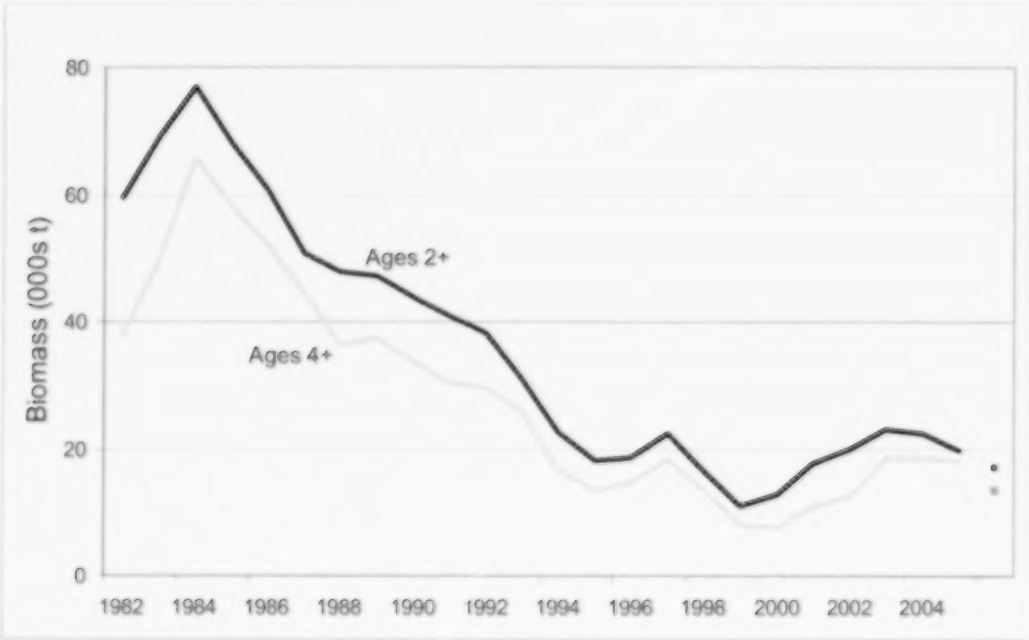


Fig. 19. Trends in biomass (000t), Western Component pollock for ages 2+ and 4+, as indicated by the consensus formulation. The population biomass trends are projected from 2005 to 2006.25 (fishing year, data point).

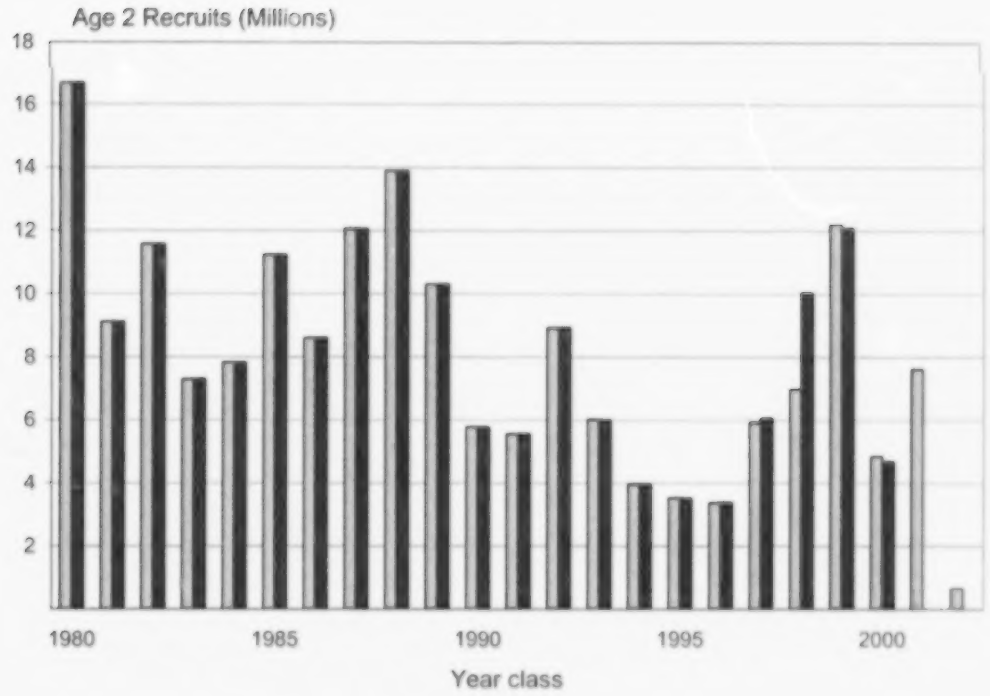


Fig. 20. Trends in age 2 recruits (number in millions) for the Western Component of pollock, as indicated by the consensus formulation. For comparison, projection results from the 2004 assessment are shown as well as current results.

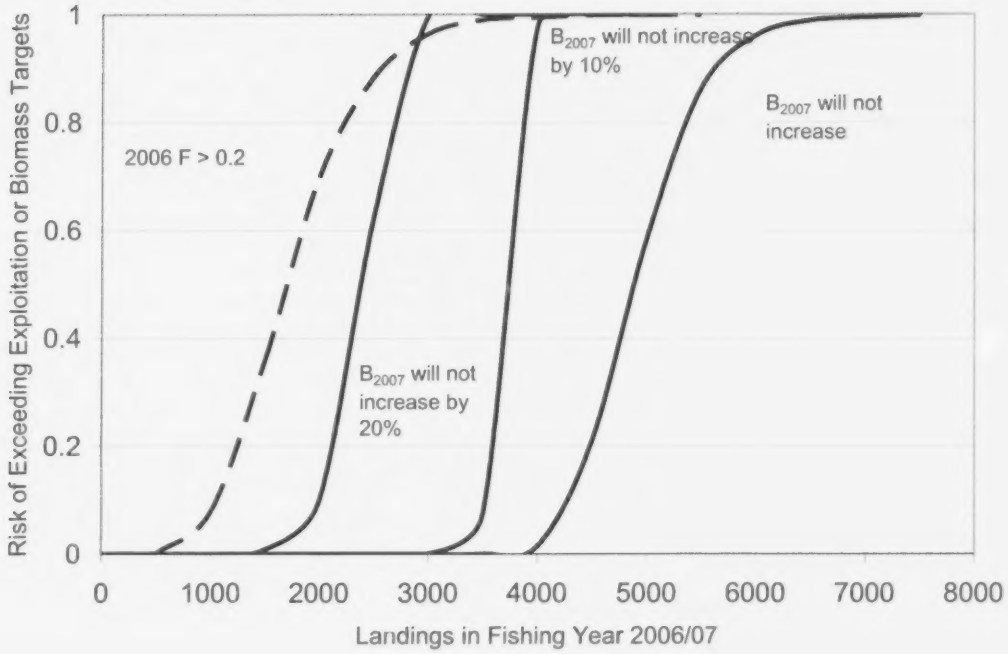


Fig. 21. Risk of exceeding exploitation or biomass rebuilding targets, Western Component pollock.

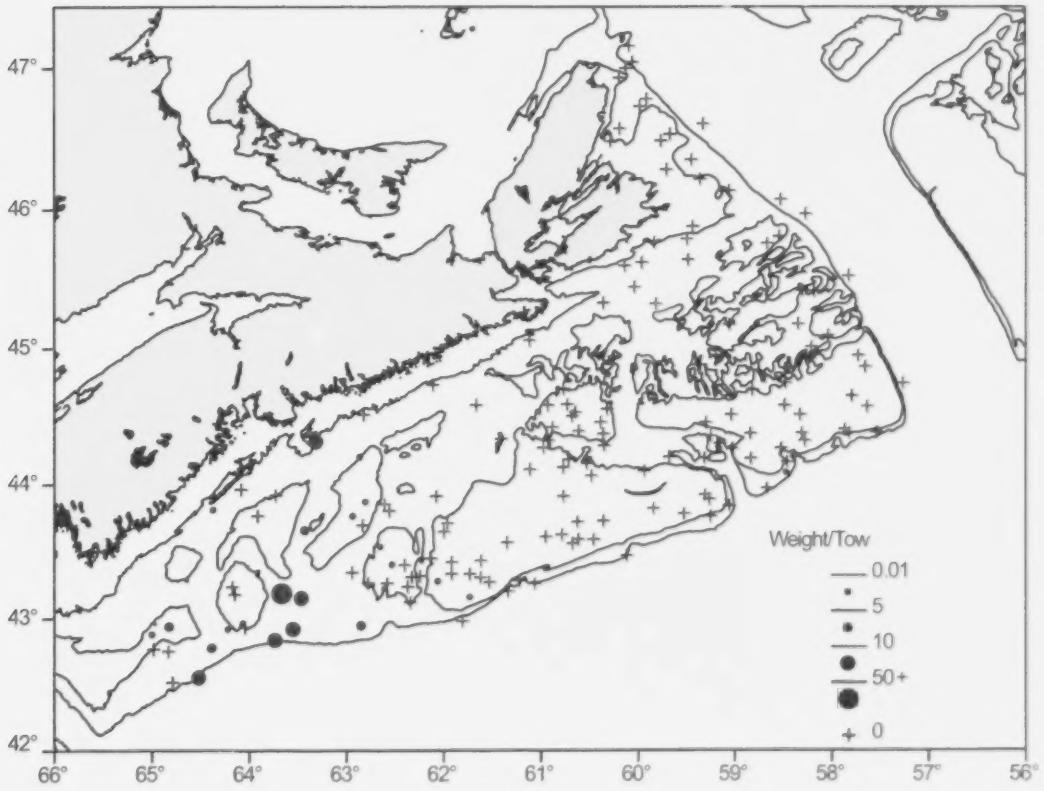


Fig. 22. Spatial distribution of pollock catches during the 2005 RV survey in the Eastern Component

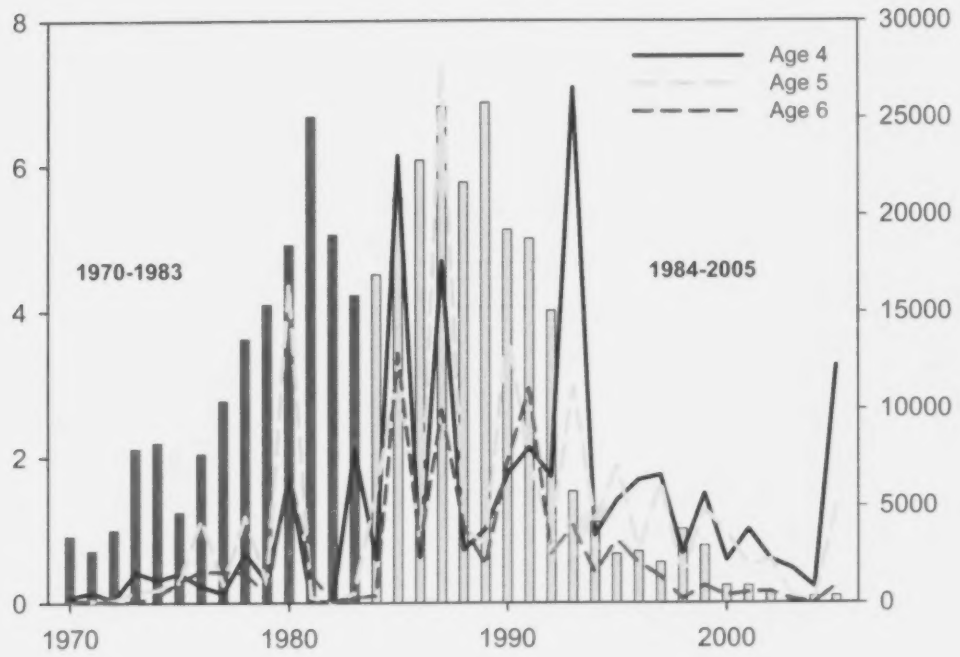


Fig. 23. Trends in landings of pollock from the Eastern Component, compared with survey indices at age (Eastern Component)

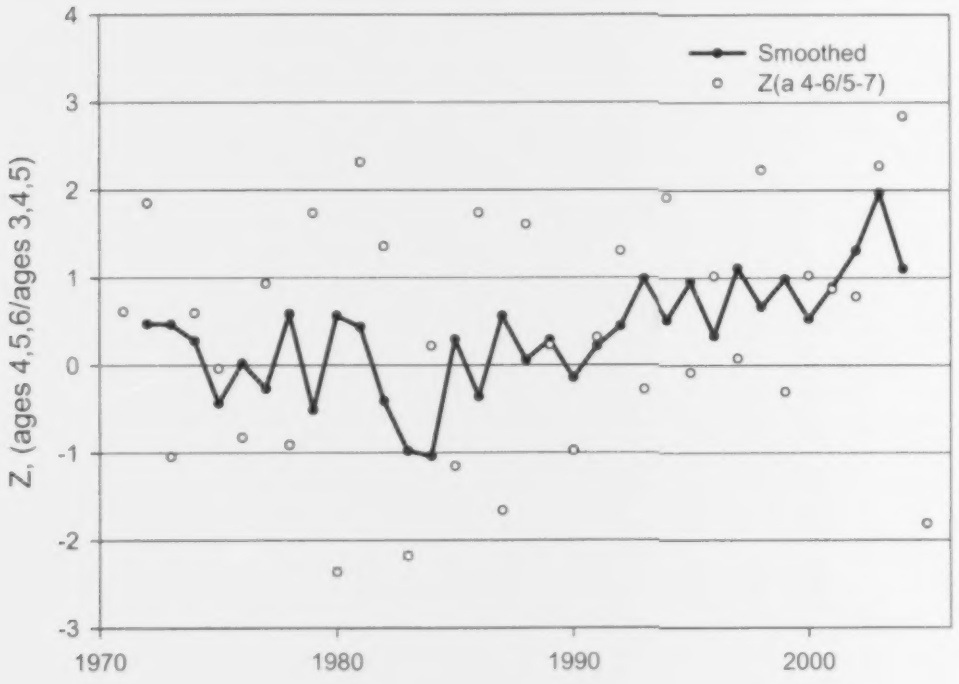


Fig. 24. Smoothed (running average of three year) estimates of total mortality from RV surveys, Eastern Component pollock. Annual estimates of total mortality (unsmoothed) are shown as open circles.

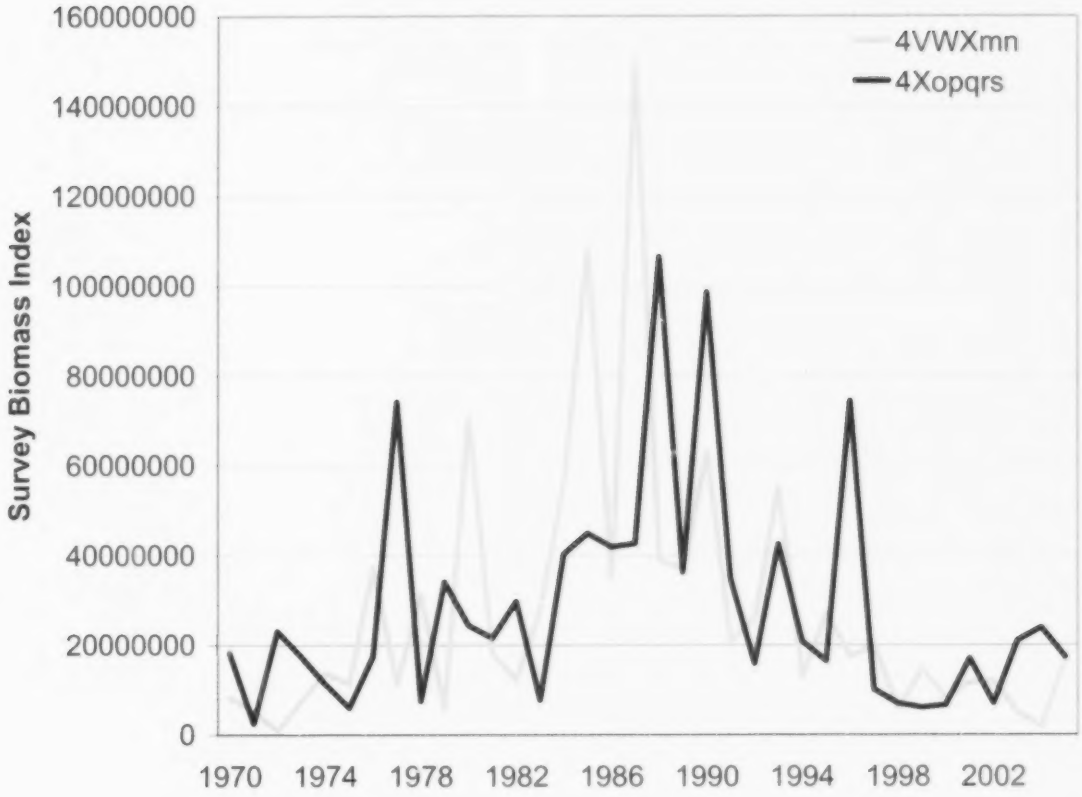


Fig. 25. Survey biomass indices from the Eastern and Western Components.

Appendix One
VPA and Projection - Western Component Pollock

CAA

	2	3	4	5	6	7	8	9	10	11	12	13
1982.00	95	1618	1352	371	1031	838	425	145	45	33	13	0
1983.00	45	1283	3966	854	179	314	291	138	59	17	19	0
1984.00	4	370	1832	2751	465	85	148	114	41	19	2	0
1985.00	5	195	621	1806	2142	328	38	100	99	62	30	0
1986.00	1	162	1410	1136	1329	876	88	37	37	41	15	0
1987.00	5	104	628	1622	883	786	490	68	17	15	28	0
1988.00	19	425	990	1126	1281	519	424	242	22	14	20	0
1989.00	93	386	1533	1129	576	463	147	129	65	6	7	0
1990.00	47	776	1102	1621	873	429	174	138	49	23	10	0
1991.00	58	1013	1900	1506	1395	347	157	56	49	25	10	0
1992.00	46	1250	2678	1651	675	314	124	96	61	14	12	0
1993.00	4	551	1989	2125	1143	318	92	27	10	7	6	0
1994.00	51	259	675	1327	1151	494	166	59	14	8	2	0
1995.00	24	263	537	949	676	294	63	17	4	1	1	0
1996.00	14	202	949	710	473	256	55	15	0	0	1	0
1997.00	6	151	900	1654	780	217	54	4	0	1	0	0
1998.00	7	228	829	1368	1262	307	47	16	2	1	0	0
1999.00	13	89	496	621	426	173	22	4	1	2	0	0
2000.00	86	581	404	592	319	139	27	6	1	0	0	0
2001.00	15	335	814	571	314	91	14	5	2	1	1	0
2002.00	7	191	787	1073	416	127	20	6	1	0	0	0
2003.00	2	111	1302	1331	513	120	18	5	1	1	0	0
2004.00	2	173	542	1876	696	118	13	4	2	1	0	0
2005.00	0	29	767	612	1032	133	11	4	0	0	0	0
2005.67												

RV

	3	4	5	6	7	8
1984.50	0.55	0.95	3.31	0.91	0.10	0.28
1985.50	0.10	0.50	2.84	3.61	0.75	0.00
1986.50	1.47	1.93	1.60	3.03	1.82	0.07
1987.50	0.06	0.63	1.85	1.12	2.27	1.16
1988.50	1.65	2.28	6.22	5.28	4.04	1.98
1989.50	0.10	0.49	1.36	1.96	1.87	0.57
1990.50	15.20	6.86	10.38	2.46	0.62	0.76
1991.50	1.87	1.66	2.88	2.86	0.89	0.80
1992.50	0.36	0.99	1.34	1.06	0.22	0.14
1993.50	11.94	8.14	4.14	1.82	0.51	0.02
1994.50	0.30	1.09	2.31	1.98	0.78	0.22
1995.50	1.50	1.22	1.96	0.99	0.30	0.05
1996.50	1.14	12.52	10.77	3.48	1.53	0.13
1997.50	0.35	0.48	1.62	0.76	0.08	0.09
1998.50	0.13	0.31	0.62	0.61	0.14	0.00
1999.50	0.54	0.85	0.49	0.38	0.27	0.00
2000.50	0.48	0.44	0.80	0.22	0.00	0.03
2001.50	6.98	1.82	0.65	0.18	0.09	0.02
2002.50	1.58	0.73	0.58	0.20	0.11	0.02
2003.50	0.90	6.06	2.15	0.49	0.02	0.02
2004.50	2.46	1.44	3.66	1.35	0.31	0.00

2005.50	0.08	1.23	1.35	2.41	0.42	0.00

T/C Weighted

	3	4	5	6	7	8
1982.50	0.19	0.12	0.03	0.08	0.07	0.04
1983.50	0.18	0.54	0.09	0.01	0.02	0.02
1984.50	0.04	0.24	0.39	0.07	0.01	0.02
1985.50	0.02	0.07	0.22	0.25	0.04	0.00
1986.50	0.03	0.19	0.15	0.18	0.11	0.01
1987.50	0.02	0.11	0.23	0.11	0.10	0.06
1988.50	0.02	0.06	0.10	0.13	0.05	0.04
1989.50	0.00	0.00	0.00	0.00	0.00	0.00
1990.50	0.11	0.14	0.18	0.08	0.03	0.01
1991.50	0.07	0.20	0.15	0.12	0.03	0.01
1992.50	0.13	0.29	0.15	0.04	0.01	0.00
1993.50	0.06	0.21	0.18	0.07	0.02	0.01
1994.50	0.03	0.07	0.13	0.11	0.04	0.01
1995.50	0.08	0.12	0.18	0.11	0.04	0.01
1996.50	0.06	0.30	0.20	0.10	0.05	0.01
1997.50	0.02	0.14	0.24	0.09	0.02	0.00
1998.50	0.01	0.07	0.11	0.09	0.02	0.00
1999.50	0.01	0.07	0.08	0.05	0.01	0.00
2000.50	0.09	0.06	0.08	0.03	0.01	0.00
2001.50	0.05	0.12	0.06	0.03	0.01	0.00
2002.50	0.02	0.14	0.20	0.06	0.02	0.00
2003.50	0.02	0.21	0.19	0.05	0.01	0.00
2004.50	0.02	0.07	0.22	0.06	0.01	0.00
2005.50	0.00	0.13	0.11	0.16	0.01	0.00

VPA setup

Plus Group : No plus group

Population

	2	3	4	5	6	7	8	9	10	11	12	13
1982.00												(1)
1995.00												(1)
1996.00												(1)
1997.00												(1)
1998.00												(1)
1999.00												(1)
2000.00												(1)
2001.00												(1)
2002.00												(1)
2003.00												(1)
2004.00												(1)
2005.00	(5000)											
2005.67		5000	5000	4000	2000	1000	100			(1)	(1)	(1)

F ratios

	2	3	4	5	6	7	8	9	10	11	12	13
1982.00								1.00	1.00	1.00	**wtd**	
1983.00								1.00	1.00	1.00	**wtd**	
1984.00								1.00	1.00	1.00	**wtd**	
1985.00								1.00	1.00	1.00	**wtd**	

1986.00								1.00	1.00	1.00	**wtd**	
1987.00								1.00	1.00	1.00	**wtd**	
1988.00								1.00	1.00	1.00	**wtd**	
1989.00								1.00	1.00	1.00	**wtd**	
1990.00								1.00	1.00	1.00	**wtd**	
1991.00								1.00	1.00	1.00	**wtd**	
1992.00								1.00	1.00	1.00	**wtd**	
1993.00								1.00	1.00	1.00	**wtd**	
2004.00						1.00	1.00	**wtd**				
2005.00						1.00	1.00	**wtd**				

Natural Mortality =.2

BOOTSTRAP STATISTICS

Parameter	Est.	Std. Err.	Rel. Err.	Bias	Rel. Bias
N[2005.67 3]	5.34E2	7.08E2	1.327	1.13E2	0.212
N[2005.67 4]	3.96E3	2.04E3	0.514	2.55E2	0.064
N[2005.67 5]	1.37E3	6.77E2	0.495	1.19E2	0.087
N[2005.67 6]	1.59E3	8.78E2	0.553	1.43E2	0.090
N[2005.67 7]	1.60E2	1.16E2	0.728	2.76E1	0.173
N[2005.67 8]	1.56E1	1.58E1	1.012	2.94E0	0.189
q ID#[1]	1.55E-4	2.47E-5	0.160	4.67E-6	0.030
q ID#[2]	3.56E-4	5.56E-5	0.156	3.33E-6	0.009
q ID#[3]	9.24E-4	1.46E-4	0.157	1.51E-5	0.016
q ID#[4]	1.39E-3	2.24E-4	0.162	2.59E-6	0.002
q ID#[5]	1.66E-3	2.68E-4	0.161	2.96E-6	0.002
q ID#[6]	1.51E-3	2.73E-4	0.181	2.72E-5	0.018
q ID#[7]	6.06E-6	3.10E-4	51.172	6.11E-5	10.083
q ID#[7]	1.02E0	2.61E-1	0.256	-1.09E-2	-0.011
q ID#[8]	4.70E-5	1.01E-1	2147.484	6.17E-3	131.353
q ID#[8]	9.61E-1	3.14E-1	0.327	-1.59E-2	-0.017
q ID#[9]	5.13E-4	2.37E-2	46.150	3.78E-3	7.362
q ID#[9]	7.38E-1	2.57E-1	0.349	3.57E-3	0.005
q ID#[10]	6.87E-4	1.39E-2	20.291	2.19E-3	3.196
q ID#[10]	7.00E-1	2.35E-1	0.336	1.72E-2	0.025
q ID#[11]	6.23E-4	8.32E-4	1.336	2.74E-4	0.440
q ID#[11]	6.49E-1	1.51E-1	0.232	-2.47E-3	-0.004
q ID#[12]	1.17E-4	8.95E-5	0.767	2.11E-5	0.181
q ID#[12]	8.75E-1	1.17E-1	0.134	-1.78E-3	-0.002

Bootstrap bias adjusted VPA
Population Numbers

	2	3	4	5	6	7	8	9	10	11	12	13
1982.00	16669	20863	4658	1115	2244	1992	945	405	85	103	34	1
1983.00	9117	13562	15622	2600	580	917	881	394	201	29	55	16
1984.00	11568	7424	9946	9227	1363	315	469	461	199	112	9	28
1985.00	7286	9467	5744	6495	5086	699	181	251	275	126	75	5
1986.00	7821	5961	7575	4143	3696	2248	280	114	116	136	48	34
1987.00	11229	6402	4734	4933	2372	1835	1057	150	60	62	75	26
1988.00	8600	9189	5148	3310	2585	1151	800	428	62	34	37	36
1989.00	12058	7024	7140	3324	1701	974	479	277	135	31	15	13

1990.00	13890	9788	5402	4467	1709	876	384	260	112	52	20	6
1991.00	10303	11329	7314	3432	2205	621	335	159	90	48	22	8
1992.00	5773	8383	8362	4281	1464	569	200	134	80	30	17	9
1993.00	5552	4685	5737	4445	2027	596	186	54	25	12	12	3
1994.00	8921	4542	3339	2915	1742	643	205	70	20	11	3	5
1995.00	6009	7258	3485	2127	1201	408	92	22	6	4	2	1
1996.00	3955	4898	5705	2370	893	382	74	20	3	1	2	1
1997.00	3520	3226	3828	3816	1303	310	86	13	3	3	1	1
1998.00	3363	2876	2505	2325	1646	374	62	23	7	3	1	1
1999.00	5922	2747	2149	1307	688	238	38	10	5	4	1	1
2000.00	6955	4837	2169	1314	516	185	43	11	4	3	1	1
2001.00	12278	5616	3436	1412	547	140	29	11	4	3	2	1
2002.00	4834	10039	4296	2082	645	169	34	12	5	1	1	1
2003.00	7775	3951	8047	2809	748	160	26	10	4	3	1	1
2004.00	627	6364	3135	5416	1112	159	25	6	4	2	1	1
2005.00	5000	512	5054	2079	2752	292	26	9	1	1	1	1
2005.67	4373	420	3705	1248	1447	132	13	4	1	1	1	1

Fishing Mortality

	2	3	4	5	6	7	8	9	10	11	12	13
1982.00	0.006	0.089	0.383	0.453	0.695	0.615	0.675	0.498	0.863	0.431	0.538	0.000
1983.00	0.005	0.110	0.327	0.446	0.413	0.470	0.449	0.484	0.387	0.996	0.477	0.000
1984.00	0.000	0.057	0.226	0.396	0.467	0.352	0.424	0.317	0.257	0.207	0.285	0.000
1985.00	0.001	0.023	0.127	0.364	0.616	0.716	0.262	0.571	0.502	0.769	0.580	0.000
1986.00	0.000	0.030	0.229	0.358	0.500	0.555	0.423	0.439	0.429	0.401	0.421	0.000
1987.00	0.000	0.018	0.158	0.446	0.523	0.630	0.705	0.682	0.370	0.309	0.528	0.000
1988.00	0.002	0.052	0.237	0.466	0.776	0.677	0.860	0.954	0.490	0.596	0.875	0.000
1989.00	0.009	0.062	0.269	0.465	0.463	0.731	0.410	0.708	0.745	0.238	0.686	0.000
1990.00	0.004	0.091	0.254	0.506	0.812	0.762	0.682	0.860	0.651	0.651	0.779	0.000
1991.00	0.006	0.104	0.336	0.652	1.155	0.934	0.716	0.488	0.894	0.843	0.668	0.000
1992.00	0.009	0.179	0.432	0.548	0.699	0.916	1.115	1.481	1.717	0.705	1.462	0.000
1993.00	0.001	0.139	0.477	0.736	0.948	0.869	0.773	0.793	0.577	1.041	0.766	0.000
1994.00	0.006	0.065	0.251	0.686	1.253	1.740	2.025	2.238	1.423	1.400	1.021	0.000
1995.00	0.004	0.041	0.186	0.667	0.945	1.500	1.332	1.746	1.216	0.328	0.639	0.000
1996.00	0.004	0.047	0.202	0.398	0.858	1.287	1.582	1.645	0.000	0.000	0.639	0.000
1997.00	0.002	0.053	0.299	0.641	1.048	1.407	1.131	0.430	0.000	0.550	0.000	0.000
1998.00	0.002	0.091	0.450	1.018	1.732	2.092	1.672	1.412	0.398	0.550	0.000	0.000
1999.00	0.002	0.036	0.292	0.729	1.112	1.521	0.998	0.610	0.276	0.899	0.000	0.000
2000.00	0.014	0.142	0.229	0.677	1.108	1.641	1.157	0.848	0.298	0.000	0.000	0.000
2001.00	0.001	0.068	0.301	0.583	0.977	1.222	0.732	0.687	0.786	0.550	0.639	0.000
2002.00	0.001	0.021	0.224	0.823	1.196	1.659	1.034	0.829	0.278	0.000	0.000	0.000
2003.00	0.000	0.029	0.190	0.720	1.341	1.638	1.343	0.810	0.308	0.496	0.000	0.000
2004.00	0.002	0.026	0.194	0.449	1.078	1.490	0.787	1.401	0.938	0.578	0.000	0.000
2005.00	0.000	0.052	0.216	0.473	0.648	0.779	0.511	0.783	0.000	0.000	0.000	0.000

Projection results using bootstrap bias adjusted point estimates

Projected Population Numbers

	2	3	4	5	6	7	8	9	10	11	12	13
2005.67	4373	420	3705	1248	1447	132	13	4	1	1	1	1
2006.25	5000	3892	367	3032	901	891	73	8	2	1	1	1
2007.25	5000	4093	3159	290	2276	633	597	51	5	2	1	1

Fishing Mortality

	2	3	4	5	6	7	8	9	10	11	12	13

2005.67	0.001	0.036	0.145	0.361	0.636	0.831	0.646	0.670	0.208	0.179	0.000	0.000
2006.25	0.000	0.009	0.035	0.087	0.153	0.200	0.156	0.161	0.050	0.043	0.000	0.000

M

	2	3	4	5	6	7	8	9	10	11	12	13
2005.67	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
2006.25	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

PR

	2	3	4	5	6	7	8	9	10	11	12	13
2005.67	0.00	0.04	0.18	0.44	0.77	1.00	0.78	0.81	0.25	0.22	0.00	0.00
2005.25	0.00	0.04	0.18	0.44	0.77	1.00	0.78	0.81	0.25	0.22	0.00	0.00

Beg_wt

	2	3	4	5	6	7	8	9	10	11	12	13
2005.67	0.23	0.62	1.28	1.97	2.73	3.88	5.27	6.60	8.05	9.89	10.74	10.00
2006.25	0.23	0.62	1.28	1.97	2.73	3.88	5.27	6.60	8.05	9.89	10.74	10.00
2007.25	0.23	0.62	1.28	1.97	2.73	3.88	5.27	6.60	8.05	9.89	10.74	10.00

Projected Population Biomass

	2	3	4	5	6	7	8	9	10	11	12	13	2+	3+	4+	5+
2005.67	1010	262	4750	2453	3943	513	67	27	7	10	11	10	13063	12052	11790	7040
2006.25	1155	2429	470	5961	2455	3458	383	51	20	7	9	9	16407	15252	12823	12353
2007.25	1155	2554	4050	570	6201	2457	3147	336	43	19	6	7	20546	19391	16837	12787

Projected Catch Numbers

	2	3	4	5	6	7	8	9	10	11	12	13
2005.67	2	8	283	223	423	48	4	1	0	0	0	0
2006.25	1	30	11	229	116	147	10	1	0	0	0	0
2007.25												

Avg wt

	2	3	4	5	6	7	8	9	10	11	12	13
2005.67	0.49	0.90	1.52	2.21	3.13	4.36	6.00	6.85	8.95	11.15	11.73	11.00
2006.25	0.49	0.90	1.52	2.21	3.13	4.36	6.00	6.85	8.95	11.15	11.73	11.00

Projected Catch Biomass

	2	3	4	5	6	7	8	9	10	11	12	13	2+	3+	4+	5+
2005.67	1	7	429	494	1326	209	22	9	1	1	0	0	2500	2499	2492	2062
2006.25	0	27	17	508	364	641	57	7	1	0	0	0	1623	1623	1595	1578
2007.25																